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CHEMICAL-BIOLOGICAL-RADIOLOGICAL (CBR) WARFARE AND ITS DISARMAMENT ASPECTS

A STUDY

PREPARED BY THE

SUBCOMMITTEE ON DISARMAMENT

OF THE

COMMITTEE ON FOREIGN RELATIONS
UNITED STATES SENATE

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CONTENTS

	Page
Preface	v
I. Introduction	1
II. Historical background	2
Early use of chemical weapons	2
Early use of biological weapons	3
Use of CB agents in modern times	3
First World War	3
CBR warfare—1918 to present	4
III. International agreements as to use of CBR warfare	6
Pre-World War I agreements	6
Peace treaties following World War I	7
League of Nations	7
Other post-World War I agreements	8
IV. U.S. CBR weapons and defenses	10
Chemical weapons and defenses	10
Toxic agents	10
Choking gases	10
Nerve gases	11
Blood gases	11
Blister gases	11
Smokes	11
Incendiary agents	11
Training and riot control agents	12
Incapacitants	12
Means of delivery	12
Defensive measures	13
Biological warfare weapons and defense	13
Antipersonnel BW agents	14
Antianimal BW agents	14
Anticrop BW agents	14
Means of dissemination	15
Defensive measures	15
Radiological warfare agents and defenses	16
RW agents	16
Defense against RW agents	17
V. The Soviet Union and CBR warfare	18
VI. U.S. policy as to CB warfare	20
VII. Use of CBR agents in World War II and in future wars	22
World War II	22
Military considerations involved in making decisions	23
Political and economic considerations	24
Moral considerations	24
Possible means of employment of CBR agents	27
Important military characteristics of CBR warfare agents	28
VIII. Fiscal, industrial and logistical factors	29
Budgetary support	29
Personnel in the U.S. Army Chemical Corps	30
Industrial aspects of CBR warfare	31
IX. Disarmament problems	33
CBR weapons in disarmament negotiations	33
Technical problems	34
Possible solutions	35
International agreement	35
Inspection	36
Delivery systems	37
Saboteurs	37
Exchange of scientific information	39
X. Concluding remarks	39
Appendix A, Selected bibliography	41
Appendix B, President Roosevelt's statement on poison gas warfare	43

CONTENTS

Page

Preface v
I. Introduction 1
II. Historical background 2
Early use of chemical weapons 2
Early use of biological weapons 3
Use of CB agents in modern times 3
First World War 3
CBW warfare—1918 to present 4
III. International agreements as to use of CBW warfare 6
Pre-World War I agreements 6
Peace treaties following World War I 7
Course of Nations 7
Other post-World War I agreements 8
IV. U.S. CBW weapons and defense 10
Chemical weapons and defense 10
Toxic agents 10
Choking gases 10
Nerve gases 11
Blood gases 11
Blister gases 11
Smoke 11
Incendiary agents 11
Training and riot control agents 12
Incapacitants 12
Means of delivery 13
Defensive measures 13
Biological warfare weapons and defense 13
Antipersonnel BW agents 14
Antianimal BW agents 14
Antiplant BW agents 15
Means of dissemination 15
Defensive measures 15
Radiological warfare agents and defense 16
BW agents 16
Defense against BW agents 17
V. The Soviet Union and CBW warfare 18
VI. U.S. policy as to CB warfare 20
VII. Use of CBW agents in World War II and in future wars 22
World War II 22
Military considerations involved in making decisions 23
Political and economic considerations 24
Moral considerations 25
Possible means of employment of CBW agents 27
Important military characteristics of CBW warfare agents 28
VIII. Fiscal, industrial and logistical factors 29
Budgetary support 30
Personnel in the U.S. Army Chemical Corps 30
Industrial aspects of CBW warfare 31
IX. Disarmament problems 33
CBW weapons in disarmament negotiations 33
Technical problems 34
Possible solutions 35
International agreement 35
Inspection 36
Delivery systems 37
Safeguards 37
Exchange of scientific information 39
X. Concluding remarks 39
Appendix A, Selected bibliography 41
Appendix B, President Roosevelt's statement on poison gas warfare 48

PREFACE

By Senator Hubert H. Humphrey, Chairman

The preoccupation of military strategists and disarmament planners with nuclear weapons has often excluded the consideration of the reduction and control of other armaments. One neglected category is that of chemical, biological, and radiological weapons. Seldom is any but the most incidental attention given to the nature of these weapons, their control and their use in war. In an attempt to increase interest and the amount of available information on the subject, the Subcommittee on Disarmament is issuing this staff study, "Chemical-Biological-Radiological (CBR) Warfare and Its Disarmament Aspects."

The study discusses the relevant factors to be considered in determining the extent to which the control and reduction of CBR weapons should be part of any arms control program. Of particular importance is the conclusion drawn in this study that presently known inspection measures for verifying any limitation on the production or development of chemical and biological weapons have a low degree of reliability. If these weapons are to be included in future disarmament agreements much more must be known about control features.

Apparently neither the executive branch of the Government nor private research institutions have instituted studies of ways in which these weapons might be controlled in a disarmament agreement. Such studies need to be undertaken so that if chemical and biological weapons were to be incorporated as a part of an arms control agreement effective inspection measures would be known and could be applied. This is an area in which an international conference of experts might be called profitably to consider the problems and possibilities of control. A technical conference of scientists and others familiar with the development and production of CBR weapons, from the United States, the Soviet Union, and other countries, might stimulate greater awareness of the problem and perhaps would result in recommendations for governmental policies on their control.

This study points up some other aspects of CBR warfare that have relevance to disarmament discussions.

The experience with chemical warfare in World War I illustrates the difficulty of limiting the use of a type of weapon once it has been introduced into battle. Gas first appeared in World War I on a small scale and in a nonlethal form, but its employment soon spread as to area covered, as to types of gas released, and as to the number of countries which resorted to its use.

Gas was used in World War I despite the existence of international agreements which prohibited its employment in warfare. Thus, the mere commitment on the part of a government not to resort to a particular weapon does not appear to be sufficient to prevent its being utilized. Yet, gas and biological weapons were not employed during

World War II, although most of the major powers had produced and stockpiled them.

Various explanations are given for the lack of use of these weapons. They were not considered sufficiently decisive to give a country a definite military advantage. It is also possible that the announcement by President Roosevelt in 1943, that the United States would not be the first to use these weapons, had a deterrent effect. Whatever the reasons the historical experience in the two World Wars indicates there is sometimes little relationship among such factors as the availability of a weapon and whether it will be used, and whether international agreements binding nations to refrain from its use will be observed.

The information contained in this study has value with respect to several aspects of national policy: Arms control, military strategy, civil defense, and peaceful application. Perhaps the dissemination of the material contained here will stimulate greater awareness of the problems posed by CBR warfare and the control of CBR weapons. It is obvious that until more is known about the control and verification of a ban on CBR weapons production any disarmament conference would have an almost impossible task of writing a treaty removing these weapons from national arsenals.

The study was prepared under the direction of the Subcommittee on Disarmament by Col. Charles H. Donnelly, senior specialist in national defense, Legislative Reference Service, Library of Congress. It does not necessarily reflect the views of the subcommittee or any of its members.

AUGUST 29, 1960.

CHEMICAL-BIOLOGICAL-RADIOLOGICAL (CBR) WARFARE

I. Introduction

In the post-World War II efforts to seek and maintain peace and to keep the military strength of the United States at a level which would safeguard the national security, our major attention has been centered on the nuclear weapons family which was introduced so sensationally in the closing days of World War II. This startling example of the ability of scientists to unlock doors to natural forces of almost incomprehensible magnitudes has created a worldwide uneasiness—sometimes even a dread—over what new discoveries may lie ahead which may lead to other forms of mass destruction.

While the dominant position of the nuclear weapon in the field of mass destruction may go unchallenged indefinitely, many scientists and students of warfare believe that the potentialities of toxic chemical compounds and disease-producing micro-organisms are such that they constitute a serious future threat to our national security. Some even believe that the magnitude of this threat approaches that of the nuclear weapon.

This study is primarily concerned with the relationship of CBR warfare to our national security and the scope of the problems which it would pose in any effective disarmament plan.

Definition.—The term "CBR warfare" is commonly used to denote that kind of warfare which produces casualties through the use of toxic or disease-producing chemical, biological, or radiological agents, or the defense against such agents.

The U.S. Army defines the branches of CBR as follows:

> Biological warfare (BW)—Employment of living organisms, toxic biological products, and chemical plant growth regulators to produce death or casualties in man, animals, or plants; or defense against such action.
>
> Chemical warfare (CW)—Tactics and technique of conducting warfare by use of toxic chemical agents.
>
> Radiological war (RW)—The employment of agents or weapons to produce residual radioactive contamination as distinguished from the initial effects of a nuclear explosion (blast, thermal, and initial nuclear radiation).[1]

Chemical warfare, in practice, covers not only the use of toxic chemicals (often called gas warfare) but also smokes, flame, and incendiaries in warfare. The military use of the last three agents is, in effect, a form of conventional warfare.

[1] "Dictionary of U.S. Army Terms," AR 320-5, November 1958. (While the definitions of CW and RW do not say so, both offensive and defensive warfare are included.)

II. Historical Background

The origins of chemical and biological warfare lie deep in antiquity. The earliest known applications consisted of poisoning food, wine, and water supplies, the use of poison-tipped arrows and lances, pollution of wells and streams with dead bodies of men and animals, and the use of flames and incendiaries. While the actual weapons, means of delivery, and tactics have changed over the last 3,000 years, the purposes have not; the infliction of casualties, destruction of materials (by flame and incendiaries), and disorganization of units by creating panic have always been the results sought.

EARLY USE OF CHEMICAL WEAPONS

About 200 B.C. a Carthaginian army feinted a retreat, leaving behind large quantities of wine poisoned with mandrake root. The enemy overran the camp and drank the wine; then the Carthaginians returned and killed them while they lay in drugged sleep.

Hannibal, commanding the Bithynian fleet, won a victory over the fleet of Eumenes II of Pergamus by tossing jars full of venomous snakes into the enemy vessels; the resulting panic was understandable. One can imagine the bitter protests which must have arisen in Pergamus against these tactics.

Solon of Athens is said to have defeated the army of Kirrha, around 600 B.C., by throwing many bundles of hellebore roots into the stream from which his enemy got their drinking water. While weakened by the resulting diarrhea, they were defeated by the Athenians.

Poison-tipped arrows and lances were commonly used in the ancient world, not only in Asia but also by the tribes of Western Europe. In fact, such weapons are still in use by some primitive peoples in Africa, New Guinea, and South America.

The use of smoke and fire in warfare can be traced to the early days of history. Smoke from green wood was often used to drive out or suffocate men hidden in caves or defiles and sometimes sulfur, arsenic, resin, or pitch were added to make the smoke more irritating. Fire and incendiaries have long been used against both men and their materiel. The modern incendiary bomb is related to the Greek fire of ancient days, which burst into flame when exposed to the air. And, as one historian points out, the modern flame thrower is reminiscent, as to its results, of the old practice of pouring flaming oil down on troops assaulting a fortress. Late in the 16th century there were two notable uses of fire in important naval battles. The British used fire boats to scatter the Spanish Armada during a critical period of the engagement; 4 years later, in 1592, Admiral Yi Sun-Sin of Korea used his famous turtle-boat rams to disorganize Hideyoshi's Japanese fleet and then destroyed it with fire arrows.

A very early record cites the use of gas on a large scale at Platea and Velium, 431–404 B.C., when the Spartans used burning sulfur and pitch to form sulfur dioxide (about one-fourth as irritating as chlorine) in the siege of these Athenian cities.

In the Crimean War the British turned down a proposal to use sulfur dioxide vapor during the siege of Sebastopol. The use of chlorine gas shells against entrenchments was considered by the Union during the Civil War but never put into effect. And during

the Russo-Japanese War the Japanese burned rag torches soaked in arsenical compounds to create choking fumes which were carried downwind over the Russian trenches.

EARLY USE OF BIOLOGICAL WEAPONS

Historical accounts indicate that biological warfare agents have been used in several forms since ancient times. The pollution of sources of water supplies was common, for one reason because the process of war always makes plenty of decaying organic matter available. As late as 1863 troops retreating from Vicksburg delayed their pursuers by driving farm animals into ponds and shooting them. The account adds, "we had to haul their stinking carcasses out to use the water." [2] The lack of any condemnatory remarks in the narrative of this incident may imply that this was a fairly common practice on both sides.

Spreading of disease germs was not uncommon. One device was to drop corpses of plague victims inside the walls of a fortress or in a well. This latter device was quite effective in desert warfare where wells were scarce. During the French and Indian War many Indians died from having used blankets and clothing from patients infected with smallpox. Many other instances can be cited, but none has been found where the use of biological warfare agents was strategically decisive.

USE OF CB AGENTS IN MODERN TIMES

First World War

Chemical warfare in its modern form was introduced in World War I. The French used hand and rifle grenades filled with tear gas in trench raids in 1914 and the Germans retaliated with tear gas artillery shells. This gas was not lethal and the effect was that of a temporary irritant. Neither the Allies nor the Germans provided their troops with masks as protection against these sporadic harassing attacks and this was to be significant in light of what was to follow.

These harassing operations were only a prelude to the first full-scale attack with lethal gas which the Germans launched on the evening of April 22, 1915. The attack took place in the Ypres salient and the first troops to suffer were the French and Canadians. A 4-mile breach in the Allied line resulted when the gas-defenseless troops gave way, but the Germans failed to exploit their sudden success and British reserves succeeding in closing the gap. About 30 hours later the Germans launched a second gas attack which opened some local gaps but, again, the advantage was not exploited. Both of these attacks were made with chlorine gas released from thousands of cylinders to form a cloud, about seven feet high, which drifted along with the wind and seeped into the Allied trenches and dugouts.

The British made their first gas attack at Loos on the morning of September 25, 1915, releasing a gas cloud. While this achieved some initial success, it was small compared to the 4-mile gap caused by the surprise attack at Ypres 6 months previously and at one stage a change in direction of the gas cloud brought it into contact with British troops.[3]

[2] Sherman, Gen. W. T., "Memoirs." New York, Charles L. Webster & Co., 1891, vol. 1, p. 359.
[3] Buchan, John, "A History of the Great War," Boston and New York, Houghton Mifflin, 1922, vol. 2, pp 43 et seq; 312.

The first gas attack made by the AEF was on the night of June 18–19, 1918, in the Toul sector. The attack was launched by the 1st Battalion of the U.S. 1st Gas Regiment, using some 2,000 gas bombs launched by Livens projectors.

During the remainder of World War I developments in gas warfare came fast. On the offensive side, the cylinder gave way to artillery, mortars, and Livens projectors as the principal means of delivery. The advantage of these weapons over cylinders was that concentrations of gas or vapor could be quickly built up in any areas within artillery or mortar ranges with much less limitation resulting from wind conditions. The early irritating and asphyxiating gases were augmented and largely supplanted by more toxic choking and blister gases—phosgene, phosgene and chlorine, and mustard gas. Flamethrowers were also developed and frequently used.

On the defensive side, after the attack at Ypres in April 1915 the Allies quickly devised crude masks which were fairly effective against chlorine but, as new types of gases were introduced, these masks were found to be inadequate and later designs giving a much broader and more complete protection were soon supplied to the troops. In fact, defensive measures were so successful that gas lost its potential as a strategic weapon in World War I.

One authority cites that a total of 124,200 tons of toxic gases were used in the 1915–18 period of which the participants used the following amounts:

	Tons
Germany and Austria	66, 400
Allies (Great Britain, France, Russia, Italy, and the United States)	57, 800

On the allied side, France and Great Britain used the major portion, with Russia accounting for 5,200 tons and the United States 1,100 tons.[4]

Very little use was made of biological warfare agents during the 1914–18 period. There is, however, evidence that the Germans succeeded in inoculating with disease germs some animals which were being shipped from the United States to Europe, and that they did the same with some horses of the Rumanian cavalry.[5]

CBR Warfare—1918 to present

Chemical warfare reached its all-time peak during the First World War. The next use reported was during the Abyssinian campaign in 1936 when Mussolini's airplanes dropped mustard gas on the barefooted troops of Abyssinia. Other toxic gas attacks have been attributed to the Japanese forces against the Chinese from 1937 to about 1943. The Chinese also claimed that the Japanese introduced plague-infested fleas by airplane.

In World War II, chemical warfare was confined to the use of smoke, flame, and incendiaries. While both sides were prepared to use and to defend against the use of toxic gases, the belligerants refrained from such use, with the possible exception of the incidents attributed to the Japanese in China.

Our Army Air Forces used fire bombs, consisting initially of belly tanks filled with a mixture of diesel fuel and gasoline and later of napalm and gasoline. The ground forces were also equipped with

[4] Wachtel, Curt, Chemical Warfare. Brooklyn, Chemical Publishing Co., Inc., 1941, p. 4.
[5] Department of the Army TM 3-216, 1956, p. 5.

flamethrowers, small ones carried by individuals and large ones mounted in tanks. These flamethrowers were very effective at times in enabling the U.S. Army and Marine forces to cope with Japanese troops who had holed up in caves and dugouts.

The Japanese urban areas were particularly vulnerable to incendiary attacks and the U.S. Strategic Bombing Survey credits these attacks as having had "profound repercussions on civilian morale and Japan's will to stay in the war." [6]

Screening smokes were widely used by both sides to conceal tactical dispositions and operations, both on land and at sea.

Radiological warfare has never been used. Nuclear warfare made its initial appearance at Hiroshima and Nagasaki with atom bombs which were air bursts. The radiation casualties, therefore, were all due to initial radiation and not fallout. Of the total fatalities, most resulted from blast effects and burns but 30 percent of all who died were estimated to have received sufficient radiation to have caused death; many of these died from mechanical or thermal effects, however, before the radiation effects could bring death.[7]

During the Korean war the Chinese Communist regime made strong efforts to have the world believe that the United States had been guilty of using biological agents against the Chinese-Korean Communist forces. Statements accusing the United States of "cruel and inhuman bacteriological warfare" against the inhabitants of North Korea and northeast China were broadcast repeatedly. A so-called international scientific commission was invited by the Peiping regime to investigate the alleged facts and the report of this group was signed on August 31, 1952.[8] The report obligingly upholds the Communist charges.

The Communist case was based upon the testimony reputedly given by four captured U.S. Air Force lieutenants, several captured intelligence agents, and by various indigenous persons who reported they had discovered unusual numbers of fleas or other insects in certain areas after American planes had flown over them; areas which they claimed had been free from such pests the day before the U.S. planes appeared. Laboratory examinations were said to indicate that these insects carried disease-producing micro-organisms. The Communists also claimed that our forces had used air-bursting leaflet bombs to introduce disease-carrying insects.

One of the interesting points about the Communist charges was their similarity to the Chinese accusations against the Japanese during World War II of having used bacterial weapons; in fact, the Communists mention this similarity themselves. Another point of interest was their seizing upon articles and reports by U.S. officials, on the subject of U.S. concern with biological warfare, apparently to sustain charges that we were continuing our study and research in this field with field experiments at the expense of the Communist peoples.

[6] U.S. Strategic Bombing Survey, "The Effects of Strategic Bombing on Japan's War Economy." U.S. Government Printing Office, 1946, p. 2. This report also states (p. 62) that high explosive bombs were much less effective than incendiaries against Japanese urban areas [largely because of the flammable character of Japanese cities at that time].

[7] U.S. Department of Defense and U.S. Atomic Energy Commission, "The Effects of Nuclear Weapons," Samuel Glasstone, editor, U.S. Government Printing Office, 1957, p. 457.

[8] Chinese Medical Journal. Special number: Bacterial Warfare. September-December 1952, vol. 70, Nos. 9-12: 326 p. [English language edition, published in Peking.] [Secretary of State Acheson referred to this group as "Communists and former Nazis who have turned Communist"; Department of State Bulletin, Apr. 7, 1952, p. 529.]

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The Communist charges were quickly and categorically denied by President Truman and other responsible U.S. officials both civilian and military. Secretary of State Acheson proposed that the International Committee of the Red Cross investigate the charges; the Red Cross officials offered their services but the Communists refused.[9] The World Health Organization of the United Nations also offered its services to make an investigation but the Communists also turned down this proposal. As Secretary Acheson pointed out, the Communists apparently realized that their charges would not bear up under the scrutiny of an impartial investigation.

III. International Agreements as to Use of CBR Warfare

Pre-World War I agreements.—Probably the first international agreement with respect to poisonous weapons was the agreement signed in Strassburg in 1675 by the French and Germans. Article 57 of this agreement outlawed the use of poisoned bullets.[10]

The "International Declaration concerning the Laws and Customs of War," adopted at Brussels in 1874, contained a prohibition against the use of poisons and poisoned weapons." [11]

The Hague Conventions of 1899 contained a prohibition against the employment of poison or poisoned arms (art. 23(a)), which the United States accepted when it ratified the convention with respect to the laws and customs of war on land.[12] A specific declaration concerning asphyxiating gases, signed at the same time, contained these conditions:

> The contracting Powers agree to abstain from the use of projectiles the sole object of which is the diffusion of asphyxiating or deleterious gases.
>
> The present declaration is binding only on the contracting Powers in the case of a war between two or more of them.
>
> It shall cease to be binding from the time when, in a war between the contracting Powers, one of the belligerents shall be joined by a noncontracting power.[13]

The United States was not one of the 25 nations which ratified this declaration, but it is interesting to note that Germany, France, Russia, and Austria-Hungary did ratify it and Great Britain adhered; all of these nations used gas warfare during World War I. One of the U.S. delegates, Admiral Mahan, in an indication of why the United States declined to be a party to the declaration, summed up his reasons for voting against the proposal as follows:

> The objection that a machine of war is barbarous has always been raised against new weapons, which were, nevertheless, finally adopted. In the Middle Ages it was firearms which were denounced as cruel. Later, shells, and more recently torpedoes have been denounced. It seems to me that it cannot be proved that shells with asphyxiating gases are inhumane or unnecessarily cruel machines of war, and that they cannot produce decisive results.
>
> I represent a people that is animated by a lively desire to make warfare humane but which nevertheless may find itself forced to wage war; therefore it is a question of not depriving itself through hastily adopted resolutions of means which it could later avail itself with good results.[14]

The Hague Convention of 1907 (IV) retained article 23(a) of the 1899 convention (II) forbidding the use of poison or poisoned weapons

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[9] Department of State Bulletins, vol. 26, Mar. 17, 1952, p. 427; Mar. 24, 1952, p. 452; Mar. 31, 1952, p. 506; Apr. 7, 1952, p. 529; May 19, 1952, p. 777; June 9, 1952, p. 911; vol. 27, Sept. 29, 1952, p. 465.

[10] Lewin, Prof. Dr. Louis, "Die gifte in der Weltgeschichte," Berlin, 1920, p. 563.

[11] Senate Subcommittee on Disarmament: Disarmament and Security, a collection of documents. 84th Cong., 2d sess., committee print, U.S. Government Printing Office, 1956, p. 170. [Hereafter referred to as Collection of documents.]

[12] Hague International Peace Conference, 1899: The Hague Conventions of 1899 (II) and 1907 (IV) respecting the laws and customs of war on land. Pamphlet No. 5, Washington, Carnegie Endowment for International Peace, 1915, p. 17.

[13] Ibid., Pamphlet No. 8, p. 1.

[14] Puleston, Capt. W. D., U.S.N., "Mahan," London, 1939, p. 204.

but said nothing more on the subject of gas warfare, thus leaving the 1899 declaration in effect as to the contracting parties.

There are several points of interest as between the 1899 declaration and the use of gas in World War I. First, the French and Germans both employed tear gas early in the war; the former used grenades and the Germans put their tear gas in shells.[15] These early attempts to use gas were little more than local harassments since the amounts used were small and the gas was not toxic; while projectiles were used, there was doubt as to whether the gases were actually "asphyxiating or deleterious."

The second point relates to the use of toxic gas in volume by the Germans on April 22, 1915. This gas was released under pressure from nearly 6,000 cylinders, forming a cloud which traveled down wind to the allied positions. Since projectiles were not used, some writers have argued that this act was not a violation of the letter of the declaration. Regardless of this, the spirit of the declaration was certainly damaged beyond repair. Both sides began to use toxic gases on a large scale and the question of legality was overtaken by events on April 6, 1917, when the entry of the United States into the war nullified the terms of the third condition of the declaration.

Peace treaties following World War I.—The Treaty of Versailles was signed on June 28, 1919, by representatives of the Allied Powers and the German Government. Article 171 of the treaty contained these provisions with regard to gas warfare:

> The use of asphyxiating, poisonous or other gases and all analogous liquids, materials or devices being prohibited, their manufacture and importation are strictly forbidden in Germany.
>
> The same applies to materials specially intended for the manufacture, storage and use of the said products or devices.[16]

Peace treaties between the Allied Powers and Austria and Hungary were subsequently signed, each of which contained prohibitions worded similarly to article 171 of the Versailles Treaty.[17]

The United States did not ratify these three treaties and subsequently negotiated its own peace treaties with the Central Powers. None of these treaties made any direct mention of poison gases but, in each of the three treaties, there was a clause to the effect that the United States should enjoy certain rights and advantages contained in the Treaties of Versailles, Saint-Germain-en-Laye, and Trianon though it had not ratified these treaties. Among the specified rights and advantages were the prohibitions relating to poison gas.[18]

It is interesting that in each of the treaties referred to above, the prohibitions regarding poison gas applied only to the Central Powers, a fact which probably had some bearing on subsequent efforts, as in the League of Nations, to extend the prohibitions to all nations.

League of Nations.—The question of how to deal with chemical and bacteriological warfare was taken up in the Council of the League of Nations first on May 17, 1920, when it was suggested that a study of chemical warfare be made with the view of arriving at some agreement on controls. This matter was referred to the Permanent Advisory Commission for Military, Naval, and Air Questions.[19]

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[15] "The Story of Chemical Warfare," Office, Chief of the Chemical Warfare Service, Washington, 1939, p. 1; also Wachtel, op. cit., p. 31.
[16] "The Treaty of Versailles and After," Department of State Publication 2724, Washington, U.S. Government Printing Office, 1947, p. 329.
[17] "Treaties, Conventions, etc.," S. Doc. 348, 67th Cong., 4th sess., 1923, pp. 3192 and 3577.
[18] Ibid., pp. 2495, 2598, 2695.
[19] Collection of Documents, op. cit., p. 172.

The Commission submitted its conclusions on October 25, 1920, to the effect that it was the opinion of the Commission that the use of asphyxiating gases was not more cruel than some other methods of warfare "provided that they are only employed against combatants." The Commission also considered that it would be impracticable to try to impose restrictions on the use of gas in war by prohibiting or limiting its manufacture in peacetime.[20]

Notwithstanding these conclusions, the Council immediately asked the Commission for further advice as to methods of control of production of poison gases. On October 28, 1920, the Commission reported that it was of the opinion that it was for the Council to consider the prohibition of the use of gas, and to take steps for enforcement measures in connection with article 16 of the covenant dealing with sanctions.[21]

The League of Nations abandoned, for the time being, attempts to set up restrictive measures against chemical and bacteriological warfare and turned to the possibility of using world opinion as a means of accomplishing its purpose. To do this, the Assembly gave to the Temporary Mixed Commission, in consultation with the Permanent Advisory Commission, the task of preparing a report which would show the probable effects of the use of chemical and bacteriological weapons in any future war.

The report of the Temporary Mixed Commission was rendered on July 30, 1924, and 2 months later the Assembly adopted a resolution calling on the Council to publish the report so that all would realize the nature of the threat from use of chemical and bacteriological weapons in future war.[22]

Other post-World War I agreements.—At the Washington Conference on Limitation of Naval Armaments, which opened on November 12, 1921, a treaty was proposed covering the use of submarines and noxious gases in warfare. Article 5 of the proposed treaty contained a prohibition against the use of poison gas in warfare.[23] The United States signed and ratified the treaty but it never came into force because France objected to the wording of the restriction covering submarines. This is the only instance the writer has found where the U.S. Senate concurred in a treaty containing limitations on gas warfare.

In 1923 the Governments of Guatemala, El Salvador, Honduras, Nicaragua, and Costa Rica signed a treaty, which came into force November 24, 1924, containing a prohibitory clause as to gas warfare similar to that in the Washington Conference Treaty.[24]

At the Fifth International Conference of the American States held in Santiago, Chile, in 1923, 17 States, including the United States, adopted a resolution which contained as point (c) of the fifth agreement a recommendation—

> that the Governments reiterate the prohibition of the use of asphyxiating or poisonous gases, and all analogous liquids, materials or devices, such as are indicated in the Treaty of Washington, dated February 6, 1922.[25]

[20] Ibid., p. 172.
[21] Ibid., p. 173.
[22] Ibid., pp. 173-175.
[23] International legislation. A collection of the texts of multipartite international instruments of general interest. Manley O. Hudson, editor. Washington, Carnegie Endowment for International Peace, 1931, vol. 2, pp. 794-798.
[24] Ibid., pp. 942-946; see art. 5, p. 945.
[25] The International Conferences of American States 1889-1928; James Brown Scott, editor; New York, Oxford University Press, 1931, p. 291.

The subject was brought up again at the Geneva Conference in 1925. The delegates of 28 countries, including the United States, signed a protocol which noted that gas warfare had been condemned by a consensus of the civilized world and prohibited by treaties to which most powers were party. It then declared that this prohibition should be extended to cover bacteriological warfare.[26] By 1939, 42 countries not including the United States, had ratified or acceded to the treaty. Several, including Britain, France, and the Soviet Union, did so with the reservation that they were not bound as to countries which did not observe the prohibitions. The U.S. Senate debated the treaty at length and then sent it back to committee where it remained buried. (This protocol was included in a number of treaties pending before the Senate which President Truman withdrew on April 8, 1947, as being obsolete.) [27]

Following the Geneva Conference of 1925, which had been sponsored by the League of Nations, further steps were attempted toward elimination of chemical and biological warfare. The Preparatory Commission for the Disarmament Conference took the matter up in 1926 and discussed the subject of prohibitions and methods of enforcement, including sanctions. The question of prohibitions was laid aside for the time being but brought up again in 1927.

During the next 6 years a series of proposals and committee reports were made, including one by the Soviet delegate which urged that all states which had not yet ratified the 1925 protocol do so as soon as possible; this proposal was adopted by the Preparatory Commission. There were wide differences of opinion as to the feasibility of controls, the wisdom of sanctions against offending states, the right of reprisal by victims of the illegal use of chemical weapons, as well as several other aspects of chemical-biological warfare.

The British delegation submitted a draft disarmament convention on March 16, 1933, of which part IV dealt with the general subject of the prohibition of chemical-biological warfare and preparations therefor, measures for supervising the observance of the prohibitions, and the question relating to the establishment of the fact of the use of chemical, incendiary, and bacteriological warfare. The paper was discussed but no further action was taken by the Conference in the matter.[28]

At the Potsdam Conference in 1945, the heads of government adopted the principle of imposing rigid control of German industry to eliminate her war potential. Production of chemicals was listed among other items. Then in 1949 the occupying powers in the Western Zone agreed to a number of prohibitions designed to prevent the rebirth of Germany as a military power, and to remain in effect until a peace settlement was concluded. Among the war chemicals proscribed were poison war gases and toxic products from bacteriological and plant sources.[29]

Had the European Defense Community come into existence, the production, import, and export of certain war materials, including atomic, chemical, and biological weapons, would have been under the

[26] Papers relating to the foreign relations of the United States. Department of State Publication 1518; Washington, U.S. Government Printing Office, 1940, vol. I, pp. 89–93.
[27] Department of State Bulletin, vol. 16, Apr. 20, 1947, p. 726.
[28] Collection of Documents, op. cit., pp. 178–188.
[29] "Ibid., p. 495.

control of the proposed commissariat.[30] However, the French failed to ratify the arrangement, which they themselves had originally proposed.

When Western Germany regained her sovereignty and became a member of the Western European Union, the German Chancellor declared that his nation would not manufacture—among other weapons—any atomic, chemical, or biological weapons.[31] Article 3 of protocol III also provided for the control of stockpiles of these weapons when manufactured by the other members.[32] No instance has been reported of the invoking of the provisions of article 3.[33]

Finally, the State treaty which reestablished Austria as a sovereign nation prohibited her from possessing, constructing, or even experimenting with atomic, chemical, or biological weapons.[34]

IV. U.S. CBR Weapons and Defenses

CHEMICAL WEAPONS AND DEFENSES

Chemical warfare agents are classified as toxics, smokes, flames and incendiaries. A fourth group is comprised of gases used for training in defense against chemical warfare and for riot control. During World War I, when chemical agents were employed as major weapons, each of the four groups was used; in the Second World War and the Korean war, only smokes, flames, and incendiaries were used in combat and these were to assist operations where other types of weapons were employed to gain decisions.

Toxic agents

This group includes gases which produce casualty effects when inhaled, ingested, or when they come in contact with the skin. There are four general types: choking gases, nerve gases, blood gases, and blister gases. A fifth type—incapacitants—is presently at the development and testing stage.

Choking gases.—These agents produce casualties by their action on the nose, throat, and lungs. A seepage of fluid from affected membranes fills the lungs and cuts off the supply of oxygen.

The April 22, 1915, attack was made with chlorine, a choking gas which was effective because the Allied troops were unprotected. As soon as crude gas masks were supplied, a mixture of phosgene and chlorine was used; phosgene is more deadly than chlorine but not sufficiently volatile to be used alone in cloud attacks, so it was mixed with chlorine. The phosgene penetrated the early masks and produced a high rate of casualties. Diphosgene was also used by the Germans and the physiological effect was the same as for phosgene. Both gases, like chlorine, are nonpersistent.

Another choking gas, chloropicrin, was used in the First World War with other gases because it often penetrated ordinary masks, causing the men to remove them and become victims to the more toxic gases. Chloropicrin is less toxic than phosgene but highly irritant, causing vomiting.

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[30] U.S. Senate, message from the President transmitting the convention on relations between the three powers and Federal Republic of Germany. 82d Cong., 2d sess., Executives O and R. 1952, pp. 197–200.
[31] Collection of Documents, op. cit., pp. 509–511.
[32] Ibid., p. 509.
[33] Statement by an official of the Department of State in a telephone conversation with the writer on May 20, 1960.
[34] Collection of Documents, op. cit., p. 527, art. 13.

Nerve gases.—These systemic poisons, developed and stockpiled (but never used) by the Germans in World War II, are the most lethal of the gases which have been standardized. There are three compounds: tabun, sarin, and soman, all having the same physiological action in that they affect the parasympathetic nervous system. The Soviets captured a tabun-producing plant and a large stockpile of this gas during the last phase of the war in Germany. The United States has adopted sarin (symbol GB) which is more toxic than tabun. All three are quick-acting casualty gases which are effective either through inhalation or contact with the skin. They are relatively cheap to make and easy to store. As to toxic effect, the former Chief Chemical Officer of the U.S. Army, Maj. Gen. William M. Creasy (USA, ret.), told a House committee that it would take 75 tons of mustard gas to equal 1 ton of nerve gas in casualty effect.[35]

Blood gases.—Three types have been developed: hydrogen cyanide (AC), cyanogen chloride (CK), and arsine (SA). The first two gases are quick acting and interfere with the utilization of oxygen by body tissues. Arsine not only interferes with the functioning of blood but damages the liver and kidneys and is a delayed-action agent.

Blister gases.—These are the arsenical and mustard gases. Mustard gas (bis(2-chloroethyl) sulfide) was the most effective gas used during World War I and produced more casualties than any other gas.[36] It is a persistent agent and, therefore, effective in harassing and interdiction actions. Besides the World War I type of mustard gas (H), there are distilled mustard (HD) and two kinds of nitrogen mustards (HN–1 and HN–3); a third (HN–2) is too unstable for efficient military use.

The arsenical blister agent is lewisite (L) which was developed just too late for combat use in World War I. It is persistent (but less so than mustard) and acts more rapidly than the mustard group.

Smokes

These agents are used for screening or for signaling; they were developed and used in World War I and also extensively used by both sides in the last World War. They are not lethal under most conditions but exposure to very heavy smoke concentrations for a short time or to lighter concentrations over prolonged periods can be injurious and the burns from the burning particles in white phosphorus smoke (WP) are painful and slow healing.

The most common screening smoke agents are titanium tetrachloride (FM), sulfur trioxide-chlorosulfonic acid solutions (FS), hexachloroethane mixture (HC), white phosphorus (WP), plasticized white phosphorus (PWP), and oil smoke which is produced from petroleum by physical means.

Incendiary agents

These include fuels for flamethrowers, flame mines, fire bombs, and incendiary grenades.

Fuels for flamethrowers and fire bombs consist of gasoline thickened with napalm, aluminum soap, or other substances which, stirred into

[35] U.S. Congress, House, Committee on Science and Astronautics. "Hearings on Chemical Biological and Radiological Warfare Agents," 86th Cong., 1st sess., Washington, U.S. Government Printing Office, 1959, p. 12.

[36] Vedder, Edward B., "Medical Aspects of Chemical Warfare," Baltimore, Williams & Wilkins Co., 1925, p. 129; also "Medical Aspects of Gas Warfare," U.S. Army Medical Department, U.S. Government Printing Office, 1926, vol. XIV p. 280.

gasoline, cause the mass to become a homogeneous gel. This gives the fuel a slower burning rate and causes it to cling to surfaces; also it increases the range of flamethrowers. White phosphorus is added as an igniter.

For destroying equipment and materiel, thermite and thermate bombs and grenades are used. Thermite is a mixture of 73 percent powdered iron oxide and 27 percent fine granular aluminum which produces temperatures of around 2,200° C. Thermate mixture includes thermite plus additives. Magnesium dust, gasoline, and asphalt are also used to make incendiary bombs.

Training and riot control agents

Chlorine is commonly used in gas chambers for training troops in use of defensive equipment and in gas discipline.

Tear and vomiting gases are used for riot control and were used extensively during the First World War as harassing agents. Tear gas is chloroacetophenone and vomiting gas is a mixture of tear gas and adamsite. These are not casualty-producing gases under field conditions and have little military purpose except their nuisance value.

Incapacitants

The spectrum of chemical warfare possibilities appears to be on the verge of very significant enlargement due to the experiments which are in progress with incapacitants. These are of two types, one rendering a person physically incapable and the other making him mentally incapable of functioning normally for a period of time, after which he recovers without ill effects.

While the project is highly classified, it has been divulged that one compound being tested is a derivative of lysergic acid, known as LSD 25. One group of incapacitants causes temporary paralysis, blindness, or deafness while another produces hallucinations and other mental aberrations which affect an individual's judgment and decision-making abilities. Both groups are nonlethal in the sense that the ratio between incapacitating and lethal doses is very large—perhaps of the order of 1,000 to 1.[37]

Since experimentation with these chemicals is far from complete, it may be several years before they are ready for military operational use. In the meantime, the potentialities of these incapacitants call for very serious consideration on the part of our planners in the fields of defense and arms control.

Means of delivery

Chemical warfare agents are spread over their targets in various ways. The most common means are by bursting-type ammunition, generating-type equipment and munitions, pressure-type weapons, and spray-type equipment.

Bombs, rockets, missiles, artillery and mortar shells, grenades, and land mines are bursting-type munitions and are used, variously, with toxic and harassing gases, smokes, and incendiary agents. The cloud-forming charged cylinders of World War I were initially effective under proper weather conditions because of the relatively fixed lines. This method of dispersion soon gave way to the use of shells and projectiles to overcome climatic restrictions on gas cloud formations, to use the element of surprise, to cope with improved defensive

[37] Hearings, House Committee on Science and Astronautics, op. cit., pp. 20-21.

equipment and tactics, and to control range and direction thus making possible a selectivity of target areas.

Smokes are often disseminated by the use of mechanical or thermal generators, especially where smokescreens are employed in friendly areas. They are also created by artillery firing smoke-producing shells.

Incendiary agents are delivered on target in various ways. Flamethrowers and mines are examples of pressure-type equipment and munitions. Portable flamethrowers came into being in the First World War and were used against personnel. These weapons, as well as mechanized flamethrowers, are very effective in dealing with personnel who are holed up in blockhouses, caves, and dugouts and were used extensively in World War II.

Incendiaries designed for destruction of buildings or material and equipment are dropped as fire bombs, or by mortar, rifle, or hand grenades. Thermite devices are also placed by hand on vital parts of materiel, such as artillery pieces, where the object is to make inoperative important equipment or weapons which may fall into the hands of the enemy.

Spray-type equipment is used in airplanes which fly over target areas and release the chemicals in the form of an aerosol.

Defensive measures

The principal means of defending against toxic chemical agents are effective warning devices; defensive equipment (protective masks and clothing); physical or chemical devices for detecting the presence of chemical agents; decontaminants, such as soap, water, and alkali powders or solutions to neutralize the agents; protective ointments for use against blister gas and arsenicals; antidotes (like atropine tartrate, carried by troops in syrettes for self-injection when exposed to nerve gases); and, perhaps most important of all, a high degree of training in defense measures and discipline in using them.

These measures are all applicable to civilian protection and, in addition, shelter protection against CBR agents is feasible. By use of proper filters in ventilating systems or diffusion-type wallboard, fallout shelters can be modified to protect against chemical and biological agents. Studies are in progress in the Office of Civil and Defense Mobilization and the Army Chemical Corps on the use of shelters to protect civilian populations from CBR agents, but it should be noted that civilian defense against CBR warfare in the United States is presently largely at the planning stage.[38]

BIOLOGICAL WARFARE WEAPONS AND DEFENSE

Biological warfare is often referred to as bacteriological, bacterial, or germ warfare but it is preferred over those terms because it includes all micro-organisms, insects and other pests, and toxic products of plant and animal life. The Army lists five groups of BW agents, including certain chemical compounds used to inhibit or destroy plant growth:[39]

Micro-organisms (bacteria, viruses, rickettsiae, fungi, protozoa).
Toxins (microbial, animal, plant).

[38] OCDM, "The National Plan for Civil Defense and Defense Mobilization." U.S. Government Printing Office, 1958: 32 p. also, annexes 1, 10, 23, 24, 36, 41.

[39] U.S. Department of the Army TM 3-216, "Military Biology and Biological Warfare Agents," Washington, U.S. Government Printing Office, 1956. p. 6.

Vectors of disease (arthropods (insects and acarids), birds, and animals).

Pests (of animals and plants).

Chemical anticrop compounds (plant growth inhibitors, herbicides, defoliants).

Biological warfare agents, like CW agents, vary in lethality, thus making it possible to select an agent best suited to accomplish the objective desired, whether it be temporary incapacity with little after effects or serious illness and many deaths. There are some important basic differences between BW and CW other than their scientific classifications. BW agents have an incubation period of days, sometimes weeks, which produces a lag in their action while CW weapons usually bring reactions within a few seconds to a few hours. CW agents are easier to detect than BW agents, and identification of the latter could often be too late to permit effective countermeasures. CW weapons generally remain effective in storage for longer periods since they are not as affected by cold, heat, dryness and similar factors as are BW agents. BW weapons theoretically are more dangerous, weight for weight, than CW agents, though this advantage may be canceled because of loss of virulence by BW agents under exposure. Meteorological conditions affect the two classes of weapons differently in some instances. A high wind which would make cloud concentrations of CW gas impracticable might render certain biological weapons more effective by covering larger areas during their decay period. Also, sunlight and unfavorable temperatures are more likely to affect BW than CW agents.

Antipersonnel BW agents

Possible agents which might be used against either military or civilian personnel, ranging in mortality effect from very low (e.g., influenza) to very high (e.g., anthrax or plague) are—

Bacteria: Anthrax, dysentery, brucellosis or undulant fever, cholera, diphtheria, gastroenteritis, glanders, melioidosis, paratyphoid fever, plague, tuberculosis, tularemia, and typhoid fever.

Rickettsiae: Typhus, scrub typhus, Rocky Mountain spotted fever, and Q fever.

Viruses: Psittacosis, encephalitic diseases, influenza, smallpox, yellow fever, dengue fever, and infectious and serum hepatitis.

Fungi: Coccidiodomycosis, histoplasmosis, and nocardiosis.

Toxins: Botulism and staphylococcic food poisoning.

Antianimal BW agents

Agents which might be used to incapacitate or destroy domestic animals are—

Bacteria: Anthrax, three closely related species of brucella, and glanders.

Viruses: Foot-and-mouth disease, rinderpest, Rift Valley fever, vescular stomatitis, vesicular exanthema, hog cholera, African swine fever, fowl plague, Newcastle disease, and equine encephalomyelitis.

Anticrop BW agents

Three kinds of agents are used: micro-organisms, which are disease-producing; pests, which cause mechanical injury to plants or act as vectors for spreading disease; and chemical compounds which kill

plants. These agents would be used as economic weapons—to limit food supplies and destroy industrial crops such as cotton, rubber, and timber:

Plant pathogens: Potato blight, brown spot of rice, blast of rice, cereal stem rust, crown rust of oats, corn smut, tobacco mosaic disease, curly top disease of sugar beets, block rot of crucifers, and potato ring rot.

Insects and other pests: Japanese beetle, Mexican bean beetle, Colorado potato beetle, cotton boll weevil, locusts or grasshoppers, hessian fly, army-worm, corn earworm, leafhoppers, nematodes, and giant African land snail.

Chemical anticrop agents: Plant growth regulators known as 2,4-D, 2,4,5-T, and IPC, which kill effectively when used at rates as low as 0.05 pound per acre; defoliants, such as ammonium thiocyanate and zinc chloride.

Means of dissemination

A discussion of the means of employing BW agents will be largely theoretical, since this type of warfare has not been tested in modern warfare, as far as is known.

In choosing means of delivery or dissemination, the physical nature of the agent must be considered. Micro-organisms are usually living particles and must be spread either in solid form or suspended in liquids. Aerosols containing various BW agents would be suitable for dissemination over wide areas. This could be accomplished from the air by planes or drones (spray tanks or bombs) or by free balloons; from the ground by clouds or mists projected by generators located upwind from the target area, or by shells, rockets, or missiles carrying BW warheads; and from the sea by clouds or mists launched from ships when inshore winds prevail. Rockets, missiles, and shells could also be launched from shipboard. Floating mines, launched by ship or set adrift in ocean currents and set to detonate along coastal areas, might also be used.

The nature of BW agents makes them very adaptable for use in covert or undercover operations. The fact that these agents are so concentrated, cannot be detected by physical senses, and have a delayed casualty effect would enable an operator quietly to introduce effective amounts into building ventilation systems, food and water supplies, and other places where they would be spread rapidly through contact with a heavily concentrated population.

A significant factor is that the possible area of effective coverage is generally greater with BW than with CW agents. Tests have been made which show that coverage measured in the thousands of square miles is quite feasible with biological agents.[40] Since the cost of the delivery system is usually much greater than the cost of the munition, this would be a significant factor where broad coverage was involved since it would presumably take fewer airplanes or other means in order to get a stated level of effect, than with CW agents.

Defensive measures

Defense against BW warfare is greatly complicated by the difficulties involved in detection of BW agents, a situation which is almost unique as to these weapons. They cannot be detected by sight,

[40] Stubbs, Maj. Gen. Marshall. Army Navy Air Force Register, May 9, 1959, p. 25; AGS Special Summary Report, Chemical and Engineering News, Oct. 19, 1959, p. 77.

smell, or any of the other physical senses. So far, no means have been devised for their quick detection and identification, though developments in this direction have been reported.[41] Physical detection by collection of samples of air, food, or water cannot be completed until the samples have been given laboratory tests, a process which may take hours or days. On the other hand, radiation can be detected by radiation measuring instruments and the presence of colorless and odorless toxic gases may be discovered by physical or chemical devices; where no warning devices are present, the physiological effects of such gases usually follow so quickly after exposure that many may be warned of the danger in sufficient time to protect themselves.

Detection is assisted by the prompt reporting of any unusual enemy actions which may indicate possible BW attack. The dropping of unidentified material or sprays from airplanes, use of shells or bombs with little or no blast, presence of smokes and mists of unknown nature, unexplained increase in the presence of insects such as mosquitoes, fleas, or ticks, discovery of any strange weapon lacking an apparent casualty effect—these are all methods by which a BW attack might be discovered and possible action taken to neutralize or diminish the casualty effect.

The actual means of defense against BW agents is similar in many respects to defensive measures against chemical agents. The protective mask is effective against aerosols. Immunizing shots; rigid compliance with sanitary measures such as cleanliness, pest and rodent control; protection of food and water from contamination and quarantine of contaminated places; and the education and discipline of personnel are measures which help to decrease BW casualty effects.

The decontaminating agents and procedures which are effective against chemical agents are also useful against biological agents.

In October 1959, a committee of the American Chemical Society made a report in which it concluded "that a balanced, total CBR defense is the most important objective we * * * can strive for, both from the standpoint of our citizens and as a deterrent against attack." [42]

RADIOLOGICAL WARFARE AGENTS AND DEFENSES

RW agents

Radiological agents either result from a nuclear explosion or from controlled nuclear reactions. Fission or thermonuclear weapons which are exploded on or near the surface form a fireball which rises, sucking up material from the ground which becomes radioactive from mixing with bomb material. This constitutes a fallout hazard downwind, sometimes for hundreds of miles. Nuclear weapons can be so designed and exploded as to increase or diminish the residual radiation or fallout hazard.

Radioactive products from controlled nuclear reactions, such as isotopes or atomic wastes, could theoretically be spread in much the same manner and by the same means of delivery as CW or BW agents. The principal near term injurious effects in either case result from whole body external exposure to penetrating gamma radiation. One exception is internal absorption of gamma emitting iodine 131

[41] Washington Post, Sept. 9, 1959, p. A-17.
[42] Chemical and Engineering News, op. cit., Oct. 19, 1959, p. 79.

which concentrates in the thyroid and may be a hazard. Additional longer term damage may accrue from inhalation or ingestion (e.g., as water or food contaminants) of particles containing radioactive beta emitters which have relatively shallow penetration from the standpoint of external whole body exposure but which may cause significant local injury when deposited internally. Strontim 90 is the best known example of a beta emitter. Also, particles left on the skin may cause deep beta burns.

The governing immediate (military) hazard in fallout types of nuclear and RW situations, however, is the whole body gamma ray exposure. Radioactive fallout emits both types of radiation. Alpha particles have little penetration (a sheet of paper stops them) and are not considered militarily dangerous. They may, however, enter the body as contaminants which may become a long-term hazard.

Defense against RW agents

Detection of dangerous radioactivity is relatively easy compared to that of BW or even certain CW agents. While RW agents cannot be detected by the physical senses, nuclear radiation instruments are available which make this a simple process.

These instruments are of two types: survey meters which detect and measure radiation intensity, and dosimeters which measure the cumulative radiation dosage received by an individual.

The survey meters, (e.g., ionization chamber and Geiger-Mueller types) used to locate contaminated areas and to determine the degree of gamma or beta intensity, may be carried by hand easily, and may be operated in vehicles or aircraft. Dosimeters are small devices about the size and shape of a fountain pen or pocket watch, designed to be worn on the person and to give direct readings of the total dosage which an individual has received.

The defensive measures against radiation are shielding and decontamination. Under the condition of initial high-level fallout, a shielded shelter provides the only practical defensive measure. Decontamination brought about by shielding, removing, or disposing of the sources of contamination may be considered for such time as the measured gamma radiation intensity has decayed to a tolerable exposure level. Decision as to the appropriate decontamination measure is dependent on the situation. A critical facility may require highly coordinated and limited forays by crews to scrape and dispose of the contaminated ground surface around the critical area, working in relatively high gamma radiation intensity conditions. Under less critical conditions, however, the decontamination might start after the gamma intensity has decayed to a tolerably low level at which time the type of residual radiation contaminant might be shielded effectively by paint (in case of alpha contamination) or asphalt (in case of beta radiation). Proper protective clothing and respirators would be needed by any decontamination crew to prevent inhalation or lodgment on the skin or hair of radioactive dust during this type of operation. Clothing is completely ineffective against gamma radiation.

Decontamination is probably impracticable for nonmilitary areas. Decay and natural weathering would in time reduce the hazards involved in reoccupation. To avoid intake of radioactivity proper precautions would be necessary, such as the use of uncontaminated food and water supplies.

External decontamination of personnel involves the removal of the radioactive particles from the body, the hair, or the clothing. Normal methods of bathing and laundering are effective.

It is possible that, in time, a protective therapy will be developed by which persons who are in danger of exposure to harmful radiation may receive protection. For about 10 years, scientists have been aware that when rodents were given certain chemicals before exposure to radiation, their tolerance to the radiation would be doubled. When giving these chemicals to larger animals, however, the increase in dosage necessary to take into account the greater weight of the animal has led to objectionable physiological effects. This has led researchers to try mixtures of chemicals which would have the degree of protection sought but with much lower toxicity than that of the dosage required if a single chemical were used. This technique of mixing chemicals to maintain a desired level of therapeutic effect while lowering toxicity is common research practice. One example of success along this line has been the comeback of sulfa drugs wherein several drugs are mixed and permissible dosage levels achieved which would be impossible in single drugs because of toxicity.

It is worth noting that the peacetime uses of any successful protective antiradiation therapeutic agents could be even more important than just stockpiling them for use in a war which it is hoped will never occur. Two of the most effective treatments presently used for cancer are surgery and radiation. An important factor in radiation therapy is the tolerance of the patient to radiation effects. If his tolerance is too low to permit effective use of radiation and surgery is not feasible, his prospects are likely to be poor. But if his tolerance could be increased to the point where sufficient radiation could be applied to give effective results, his chances of a prolonged useful life would be better though it must be realized that radiation does not always succeed even when the patient can tolerate it.

V. The Soviet Union and CBR Warfare

The Russians engaged in gas warfare, offensively and defensively, in World War I. In 1924, the Soviets established the Military-Chemical Army Administration in Moscow and began the formation of chemical warfare units. By 1928, according to a former Soviet Army officer who had seen service with chemical troops, Soviet doctrine recognized chemical weapons as important in both trench and mobile warfare since they could cover extensive areas, they were adaptable to surprise attacks, they could inflict mass casualties, and their cost was comparatively low.[43]

By 1941 the Soviet Army was equipped with persistent and nonpersistent toxic gases, smoke producers, and incendiaries, mostly types of World War I origin. To distribute these weapons, the Soviet armed forces had aviation bombs and sprays, artillery and mortar shells, mines, chemical tanks, and toxic smoke candles. They were also well equipped with flamethrowers and smoke producing and distributing equipment.

Colonel Pozdnyakov, the Soviet officer referred to above, commanded a chemical unit in the Soviet Army during World War II. He states that Soviet chemical units were sent to the front in the

[43] "The Red Army," B. H. Liddell Hart, editor, ch. 33, by Col. V. Pozdnyakov; New York, Harcourt Brace & Co., 1956; p. 384.

early months of the war but were not allowed to use even smokescreens for fear the Germans might use these as a pretext for accusing the Soviets of using toxic gas. He gives his opinion that the reasons the Soviets did not use gas in that war were: (1) their advance stores had been overrun by the Germans early in the war; (2) Soviet gas discipline had deteriorated; (3) many of their masks and other protective equipment had been lost or turned in to depots; and (4) the fear of retaliation was great. Later in the war, he believes that the Soviet Union was influenced by her allies not to use toxic chemicals.[44]

The Soviets have strengthened their potential to wage chemical warfare since World War II, Colonel Pozdnyakov believes; he thinks they are preparing for gas warfare and that they expect other states are doing likewise.[45]

The U.S. Army has this to say about Soviet CB capabilities:

> Chemical and bacteriological agents now in being are 10 to 50 times more potent than those of a few years ago. They can be delivered by means comparable in coverage to other large area weapon systems.
>
> The potential value of the weapon systems is well known to the Communists and all available information points with certainty to the fact that the Soviets have a stronger capability to wage a chemical and biological attack than the United States and its allies. Further they have a will to wage such an attack and have stated so openly on many occasions.[46]

The Chief of U.S. Army Research and Development, Lt. Gen. Arthur G. Trudeau, recently made this statement:

> * * * We know that the Soviets are putting a high priority on development of lethal and nonlethal weapons and that their weapon stockpile consists of about one-sixth chemical munitions. Russian leaders have boasted that they are fully prepared to use new chemical weapons of great significance and we know Soviet forces are trained in their use.[47]

Maj. Gen. Marshall Stubbs, Chief Chemical Officer of the U.S. Army, has said that the Soviets are engaged in intensive research in both chemical and biological warfare agents and that their interest lies not only in lethal agents but also in the incapacitants. This has led him to believe that they would initiate chemical and biological warfare if it were to their advantage to do so.[48]

In the Department of the Army Handbook on the Soviet Army, numerous chemical weapons and items of defensive equipment are described and illustrated.[49] The Army credits the Soviets with the ability to wage chemical and biological warfare on a large scale, with an especially large capability in chemical warfare. It is pointed out that the Soviets have much modern equipment suitable for distribution of both chemical and biological agents, including artillery running into large calibers and a great number of rockets.[50] The Soviets undoubtedly have a good stock of nerve gas since they captured a German tabun manufacturing plant near the end of the war which they took back to the Soviet Union.

In recent years, Soviet military leaders have made a number of statements reflecting their concept of what another world war would

[44] Ibid., pp. 391-392.
[45] Ibid., p. 394.
[46] House hearings on Department of Defense appropriations for 1961, 86th Cong., 2d sess., Washington, U.S. Government Printing Office, 1960, pt. 2, p. 513.
[47] Ibid., pt. 6, p. 181.
[48] Hearings on CBR warfare agents, House Committee on Science and Astronautics, 86th Cong., 1st sess., 1959, p. 31.
[49] Department of the Army Pamphlet No. 30-50-1, Washington, U.S. Government Printing Office, 1958, pp. 105-108, 196-198.
[50] House hearings on defense appropriations for 1961, op. cit., pt. 6, p. 290.

look like. Marshal Zhukov, when he was Minister of Defense, told the party congress in February 1956 that the Soviet armed forces were built up on the "fact" that a future war would differ greatly from past wars. "A future war," he said:

> should it be unleashed, will be characterized by the massive use of air forces, various rocket weapons, and various means of mass destruction such as atomic, thermonuclear, chemical, and bacteriological weapons.[51]

This concept was repeated in an article in the Soviet Army Journal in 1958, with the added observation that the use of these weapons would contribute to the success of a surprise attack.[52]

Numerous Soviet scientific and technical reports have been published which show the Soviet interest in and knowledge of both CW and BW agents and an acquaintance with the possibilities in the use of psychochemicals. Furthermore, an impressive civil defense program, including defense against chemical and biological agents, has been developed. This civil defense system is separate from but works closely with the All-Union Voluntary Society for Cooperation with the Army, Air Force, and Navy, which is known by its initials, DOSAAF. This paramilitary organization has over 30 million members and is working toward the goal of 20 hours of instruction in civil defense for every Soviet citizen.[53] In 1958 the Soviets published a comprehensive manual for the use of DOSAAF instructors which contains much information on CBR weapons and measures for defense against them.[54]

VI. U.S. Policy as to CB Warfare

The last official statement of U.S. policy as to the use of chemical and biological warfare agents was made by President Roosevelt in 1943. (See app. B.) On September 3, 1959, a concurrent resolution was introduced in the House (H. Con. Res. 433) calling for reaffirming "the longstanding policy of the United States that in the event of war the United States shall under no circumstances resort to the use of biological weapons or the use of poisonous or obnoxious gases unless they are first used by our enemies." The sponsor said he had noticed that the Department of Defense was giving increased emphasis to the CBR program and he had deduced from public statements and articles that the Department was trying to bring about three things: a better public understanding of the nature and implications of CBR warfare, a stepped-up program of research and development, and a relaxation of the existing policy strictures applying to CB warfare. He said he agreed with the first two objectives but took exception to the third, one reason being that any relaxation of the U.S. policy would be noted by other countries and might be the signal for them to use these weapons against each other, since the cost and skill involved in making them was within range of small countries.[55]

In addition, Congressman Kastenmeier asserted that in the absence of a no-first-use declaration by the United States, countries like the

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[51] Current Digest of the Soviet Press, vol. 8, No. 10, Apr. 18, 1956, p. 11.

[52] This appears in an article in Voennyi Vestnik (The Military World), No. 6, June 1958, by Col. I. Boz. It is reproduced in "Soviet Image of a Future War," by Raymond I. Garthoff, Washington, Public Affairs Press, 1959, p. 97.

[53] "Soviet Civil Defense Against CBR Attack," Armed Forces Chemical Journal, May-June 1959, pp. 16–22, 24. (Prepared by the U.S. Army Chemical Corps Intelligence Agency.)

[54] Defense against agents of mass destruction, Zashchita ot sredstv massovogo porazheniya, M. YE. Levin and others, Moscow, 1958. Also, see "Civil Defense in Western Europe and the Soviet Union," H. Rept. No. 300, 86th Cong., 1st sess., Washington, U.S. Government Printing Office, 1959, pt. III, pp. 39–109.

[55] Congressional Record, Sept. 3, 1959, pp. 16534–16536, remarks of Mr. Robert Kastenmeier.

Soviet Union which have ratified the Geneva protocol against CW and BW were deftly propagandizing that American CBR preparations were intended for aggressive use. He argued that passage of the no-first-use resolution would make American intentions clear on this point and would constitute a political victory in the uncommitted world.

While the principle expressed in House Concurrent Resolution 433 has been endorsed on the floor of the House on several occasions, opposition has also been expressed. The principal points made on the other side of the case were: [56]

In World War I, while gas casualties were high, the death rate was much lower than with other casualties and the chances of complete, unscarred, unmaimed recovery were greater.

All war is immoral and one weapon is as immoral as another; as to inhumanity, nothing could be more horrible than flamethrowers, napalm, high explosive shells, and A-bombs.

We are in a scientific and technological contest with Communists and must establish a position of strength in CBR; if we do, this will be one of the best guarantees that CBR warfare will not be used against us.

Too few people know the facts about CBR and how to defend themselves against it. On the other hand, the Russians have a very extensive program wherein millions are given practical training.

CB weapons are under development which can produce disability temporarily without permanent injury. These weapons offer a degree of flexibility which is not true of most other weapons.

Critics of CBR warfare have tended to approach the subject emotionally rather than on the basis of demonstrable facts and logical reasoning.

Failure to develop a strong CBR offensive warfare capability is to invite this kind of attack since one nation is not likely to attack another with these weapons if to do so would be to invite retaliation in kind. [This was demonstrated during World War II when both sides were well prepared to use chemical warfare but did not do so.]

A letter from President Eisenhower dated December 31, 1959, disclosed that the Department of Defense was reviewing the matter of the use of chemical and biological weapons; [57] however, at a press conference on January 13, the President told newsmen that no official suggestion had been made to him to change the U.S. policy in this matter and that his own instinct was not to start such a thing as that first. [58]

As to the outcome of House Concurrent Resolution 433, it is still pending before the Foreign Affairs Committee although no action on it is expected. Both the Defense and State Departments opposed the resolution in letters sent to the chairman of the House Foreign Affairs Committee dated March 29 and April 11, 1960, respectively.

The Defense Department said with respect to the resolution:

Similar declarations might apply with equal pertinency across the entire weapons spectrum, and no reason is perceived why biological and chemical weapons should be singled out for this special declaration. Whether the use of any major type of weapon should be initiated is a matter to be decided at the highest levels of Government in the light of the Nation's longstanding policies and principles, its international obligations, and the emergent situations it will confront. Effective controls on biological and chemical weapons, as in the case of other weapons, may have to await international agreements with necessary safeguards.

It must be considered that biological and chemical weapons might be used with great effect against the United States in a future conflict. Available evidence indicates that other countries, including Communist regimes, are actively pursuing programs in this field. Moreover, as research continues, there is increasing

[56] Ibid., Feb. 4, 1960, pp. 1953-54, remarks of Mr. Robert L. F. Sikes.
[57] Congressional Record, Jan. 18, 1960, p. A380.
[58] New York Times, Jan. 14, 1960, p. 14.

evidence that some forms of these weapons, differing from previous forms, could be effectively used for defensive purposes with minimum collateral consequences. These considerations argue strongly against the proposed resolution, which appears to introduce uncertainty into the necessary planning of the Department of Defense in preparing to meet possible hostile actions of all kinds.

The Department of Defense therefore does not recommend the adoption of House Concurrent Resolution 433.

The Department of State, in its letter of opposition, stated that—

As a member of the United Nations, the United States, as are all other members, is committed to refrain from the use, not only of biological and chemical weapons, but the use of force of any kind in a manner contrary to that organization's charter. Moreover, the United States is continuing its efforts to control weapons through enforceable international disarmament agreements.

Of course, we must recognize our responsibilities toward our own and the free world's security. These responsibilities involve, among other things, the maintenance of an adequate defensive posture across the entire weapons spectrum, which will allow us to defend against acts of aggression in such a manner as the President may direct. Accordingly, the Department believes that the resolution should not be adopted.

VII. Use of CBR Agents in World War II and in Future Wars

In this discussion the so-called conventional chemical weapons—smokes, flames, and incendiaries—will be omitted. These weapons were not the concern of the 1925 Geneva convention, which was aimed at toxic gases and bacteriological agents, and they were used freely by both sides during World War II and the Korean war. This paper is chiefly concerned with the weapons which could destroy or incapacitate large masses of people, possibly becoming weapons of decision.

WORLD WAR II

The failure of the participants in World War II (with the possible exception of several reported incidents of Japanese use in China) to employ toxic gas warfare has aroused much interest and speculation. The Germans were probably better prepared for offensive CW than any other nation; they had developed a deadly nerve gas and had a huge stockpile of it ready for use. Although Germany was a party to the Geneva convention, the United States was not, and it is not likely, in the light of history, that Hitler would have been inhibited from using this weapon if he had thought it would have helped his cause.

The Allied Nations were prepared to defend themselves against CW and to retaliate in kind but their publicly announced policy was that they would resort to the use of gas warfare only if the enemy initiated it. Apparently Hitler was convinced that he might come off second best in such an exchange, but he did not seem to be aware that, while the Allies were well supplied with defensive equipment and stocks of toxic gases, they knew little about the new nerve gas which the Germans had developed. General Creasy told a congressional committee that the Germans had decided to use gas in defense against the cross-channel invasion but the orders were never carried out; had they been, he doubted that our troops could have made a successful landing.[59]

Admiral Leahy relates that the United States was also prepared to use bacteriological warfare if necessary. He recalled that in July

[59] Hearings on CBR warfare agents, op. cit., p. 12.

1944 he had discussed the matter with President Roosevelt, in particular, an idea advanced by some scientists which would have destroyed the Japanese rice crop. However, the admiral had strongly advised against using it, and the United States did not resort to bacteriological or toxic chemical agents throughout the war.[60]

MILITARY CONSIDERATIONS INVOLVED IN MAKING DECISIONS

In any war, a decision to employ a new weapon or an existing one which has been held back is weighed most carefully from the standpoint of damaging repercussions. On one hand, it may be a tactical weapon which can bolster offense or defense but is not powerful enough, in itself, to bring about a decision. Such weapons are constantly added to the arsenal of combat troops and, in the main, they are improvements of existing weapons. On the other hand, the weapon may use a new concept and have sufficient potential to bring about a decision if used properly. Here, such factors as surprise, deployment, and exploitation of success have an important bearing on the results.

The German gas attack in April 1915 achieved complete surprise and for several hours there was a wide gap in the Allied lines. The German High Command apparently had made no plan to exploit a success of the extent attained and the British, by heroic efforts, were able to fill the gap. Thereafter, the element of surprise was lacking in most gas attacks and effective defensive equipment was soon supplied to the troops; these two factors were sufficient to eliminate the likelihood of a successful strategic use of gas warfare for the remainder of the war.

In making military plans to use CBR warfare, the first step would very likely be to weigh the advantages which could reasonably be expected to result against the disadvantages which would probably follow if the initial use did not lead quickly to victory. Retaliation with similar or perhaps even more deadly weapons would certainly have to be expected and the ability to withstand such a counterattack would need to be carefully considered. Other important factors would be knowledge of the status of the enemy's defenses against CBR weapons, the prospects of achieving surprise, degree of toxicity to be employed, the available supply of CBR weapons and means of delivery, and the ability to continue with further attacks if desired.

Any military decision to use CBR warfare would most certainly be made, however, in the light of other important factors such as political, economic, health, and perhaps even moral considerations. From the military point of view, the use of gas during some of the tactical operations in the Pacific during World War II might have made possible the gaining of our objectives with much less loss of American lives.

Ernest K. Lindley wrote this during the war:

> The use of gas would have enabled us to capture Tarawa almost without a casualty.
>
> If the tons of bombs dropped on Tarawa from the air had been [mustard] gas * * * in all probability not a defender would have survived. * * * In the end, every Jap on Tarawa was killed or committed suicide anyway, except a handful of laborers and a few soldiers captured while unconscious. But the victory cost us, in dead and wounded, several thousand of our most valiant youth.[61]

[60] Leahy, William D., "I Was There." New York: Whittlesey House, 1950, pp. 439–440.
[61] Newsweek, vol. 22, Dec. 20, 1943, p. 24.

General Creasy made the same kind of an observation about the Battle of Iwo Jima. He recalled that the Japanese had 21,000 troops defending the island, practically all of whom were killed or committed suicide. The Americans suffered nearly 27,000 casualties, including 6,775 dead.[62]

The fact that the United States did not use gas warfare under the conditions described above is an excellent example of the fact that, in modern warfare, military considerations must often give way to others which are considered to be overriding.

Because of the unique characteristics of BW agents, consideration would also be given to the use of these weapons to attrite the strength of an enemy since they are not suitable, by themselves, for surprise attacks where speedy effect is desired. They could be valuable, however, in sapping the strength of an enemy's military and industrial manpower through the medium of sporadic attacks, which might be very difficult to detect especially if carried out by well-trained saboteurs.

An important prerequisite in planning the employment of CBR warfare, besides knowing the capabilities of the weapons, is the development of a sound doctrine for their use. Good doctrine evolves through experience and the battlefield is the best testing ground. However, there has been no opportunity to test biological or modern chemical weapons in battle so the best substitutes are field tests and wargaming. As new weapons are being developed, the process of producing a tactical doctrine for their use goes hand in hand. A point sometimes overlooked is that constant research and development of new CBR weapons and the production of doctrine for their use are just as essential to creation of an effective defense as for offensive employment. Unless there is thorough understanding of the nature of a weapon and how it may be used, it is nearly impossible to plan an effective defense against it.

POLITICAL AND ECONOMIC CONSIDERATIONS

Apart from any consideration of the ethical or humanitarian issues involved, no nation is likely to initiate the use of weapons of mass destruction or incapacitation on military considerations alone. To ignore the possible effects which such an action might have on that country's international relations, its economy, and its national health, would be to ignore considerations which might outweigh the military factors. Also, the country might be a party to treaty restrictions which it would not want to disregard.

A nation would be likely to think twice before unleashing a mass attack with nuclear or biological weapons if the effects might spill over borders and harm allies, friends, or even neutrals. And if the objective of the attack was subjugation rather than genocide, the aggressor would have to reckon the cost of keeping his enemy alive after their surrender until the defeated people could take care of themselves.

MORAL CONSIDERATIONS

A comprehensive presentation of this aspect of CBR warfare, alone, would far exceed the dimensions of this study. The moral aspects have an important bearing on the possible use of CBR agents in future wars, however, and should be considered in relation to other factors.

[62] Hearings on CBR warfare agents, op. cit., p. 7.

The moral issues involved in CBR warfare are a part of the whole question of the morality of warfare. Assuming that under certain conditions a nation is morally justified in using armed force—certainly to defend itself when attacked—the question arises as to how much force is justified. The generally accepted answer is: only as much as may be necessary to carry out one's objective. Capt. Liddell Hart puts it like this:

> Self-interest as well as humane reasons demand that warring nations should endeavor to gain their end * * * with the least possible permanent injury to life and industry. To inflict widespread death and destruction is to damage one's future property, and, by sowing the seeds of revenge, to jeopardize one's future security.[63]

By the turn of the century, those who had striven to remove some of the barbarism from war took considerable comfort from the creation of the Hague Conventions and Declarations of 1899 and 1907, only to see much of their work undone during the First World War. The first toxic gas attack at Ypres came as a shock to the civilized world and subsequent accounts played up the high rate of casualties to the defenseless Allied troops in very condemnatory terms. This attack was added to the war "atrocities" and undoubtedly the event had much to do with the public attitude toward chemical warfare.

In the peace treaties following the surrender of the Central Powers, gas warfare was specifically prohibited and in subsequent conferences dealing with limitation of arms, draft treaties almost invariably contained language to the effect that gas warfare had been condemned by the general opinion of the civilized world.

At the beginning of the Washington Disarmament Conference in 1921, Secretary of State Charles Evans Hughes proposed an attempt to control the use of poisonous gases because, he said, "the sense of humanity had been outraged." [64]

General Pershing had very strong views as to gas warfare which were expressed in a resolution which he submitted for adoption by a subcommittee of which he was chairman:

> Chemical warfare should be abolished among nations as abhorrent to civilization. It is cruel, unfair, and improper use of science. It is fraught with the gravest danger to noncombatants and demoralizes the better instincts of humanity.[65]

About this same time the General Board of the U.S. Navy was asked: Should gas warfare be abolished? The Board replied: "Yes," and gave this comment:

> The tendency of rules of modern warfare is toward restraint in the employment of weapons that produce unnecessary suffering. * * * Following this general principle, gases which produce unnecessary suffering should be prohibited.
> * * * Gas warfare [may pass] beyond the control of the belligerent agent and may involve a sacrifice of innocent lives over a wide area.[66]

In 1937, President Roosevelt vetoed a bill which would have changed the name of the Army "Chemical Warfare Service" to "Chemical Corps," pointing out that the designation "Corps" should be reserved for a supply branch which had some combat functions. He then explained his objections:

> I have a far more important objection to this change of name. It has been and is the policy of this Government to do everything in its power to outlaw the use of

[63] Marine Corps Gazette, vol. 44, January 1960, pp. 14–15.
[64] Congressional Record, 69th Cong., 2d sess., Dec. 9, 1926, vol. 68, pt. 1, p. 142.
[65] Ibid., p. 226.
[66] Ibid., p. 143.

chemicals in warfare. Such use is inhuman and contrary to what civilization should stand for.[67]

In the conversation which Admiral Leahy had with President Roosevelt in 1944 as to the use of crop-destroying agents, he said to the President:

> Mr. President, this [using germs and poison] would violate every Christian ethic I have ever heard of and all known laws of war. It would be an attack on the noncombatant population of the enemy. The reaction can be foretold—if we use it the enemy will use it.[68]

The position which President Roosevelt took as to the use of poison gas during World War II was that the United States would not use "such terrible and inhuman weapons" unless they were first used by our enemies. (The full text appears in app. B.)

The "inhumanity" of gas warfare was strongly challenged, however, by many who were as sincere in their convictions as were those who condemned its use. Much of this other point of view came out during the Senate debate over ratification of the Geneva Poison Gas Treaty of 1925.

Senator Wadsworth said that, following the war, there had been much misinformation and hysteria over this matter; he said:

> We have the information now complete, based upon facts that are incontrovertible, which indicates very, very clearly that, compared with other weapons used in warfare, gas is the least cruel, not only in the effect at the time of its use but in its aftereffects. If we are to base our action upon the relative cruelty of weapons, we would better go to the high-explosive shell and attempt to draw a convention which would prevent nations from using it, for if we compare the effect of high explosives, bullets, and shrapnel on the one side with the effects of gas upon the other we cannot help reaching the conclusion that gas, while an extraordinarily effective weapon from the military standpoint, is the least cruel of the lot.[69]

Senator Wadsworth and others who backed his stand made considerable use of a report issued by the Surgeon General of the U.S. Army.[70]

There were a total of 258,338 American soldiers killed and wounded during World War I (not counting Marines). Of these, the Adjutant General of the Army reported that 34,249 had been killed in action, of which 200 were estimated to have died from the effects of gas.

Of the 224,089 who were hospitalized for wounds, 147,651 (65.90 percent) were for gunshot injuries and 70,552 (31.49 percent) were gas casualties; the other 5,886 casualties resulted from other weapons and agents.

Of the 13,691 deaths which resulted from these injuries, 12,192 (89.05 percent) died from gunshot injuries, 1,221 (8.92 percent) from gas, and 278 (2.03 percent) from other military agents. The rate of deaths per hundred injuries was: gunshot injuries, 8.26; gas, 1.73; all other military agents, 4.72.[71]

Also significant was the report on the 20,588 cases who were eventually discharged in 1918–19 for 10 percent or more disability. Of these, 17,176 were from gunshot wounds, 2,853 from gas injuries, and 559 from other military agents.[72] As to the incidence of tuberculosis,

[67] Congressional Record, 75th Cong., 1st sess., 1937, vol. 81, pt. 7, p. 8198.
[68] Leahy, op. cit., p. 440.
[69] Congressional Record, op. cit., vol. 68, p. 144.
[70] Report of the Surgeon General of the U.S. Army to the Secretary of War, Washington, U.S. Government Printing Office, 1920.
[71] Ibid., p. 57.
[72] Ibid., p. 58.

173 cases developed among the 70,552 gas casualties, a rate of 2.45 per 1,000. This compares with an overall rate among U.S. enlisted men in Europe in 1918 of 3.50 per 1,000 and, in 1919, of 4.30 per 1,000.[73] As to blindness, of 754 cases resulting from battlefield injuries, only 29 were the result of gas injury.

These statistics show that in U.S. Army forces in World War I, gas injuries accounted for about 27 percent of all battlefield casualties but only 2 percent died from these injuries while 24 percent died from gunshot and other injuries.

In the British Army, 3.3 percent of the gas casualties died but this included the heavy casualties at Ypres when the surprise attack caught the Allied forces without protection; 36.6 percent of their battlefield casualties died from other weapons. The figures for the German Army were: deaths from gas injuries, 2.9 percent; deaths from casualties resulting from other weapons, 43 percent.[74]

High-ranking military men also believe that the public has a very wrong conception of the humanity of gas warfare. Lt. Gen. Arthur G. Trudeau, Chief of Research and Development in the Army, said:

> Most of those who [throw up their hands in horror at the mention of gas warfare], I am sure never have seen the horrors caused by shot and shell. Personally, if I had to be a casualty, I would far rather be gassed than shot.[75]

Congressman Collins of Mississippi probably summed up the attitude of many who believe that the United States should retain its freedom of action as to CBR warfare when he observed:

> Most people object to the use of gas when they should really object to the institution of war.[76]

POSSIBLE MEANS OF EMPLOYMENT OF CBR AGENTS

A weapon has strategic capabilities if it is sufficiently effective to neutralize or destroy any element essential to the winning of a war. In April 1915 the Germans had a strategic weapon in their toxic gas; if they had exploited its full capabilities, they might have split the French and British forces, sealed off the channel ports, and defeated the divided armies. As soon as the Allies improvised some gas masks, however, poison gas lost its strategic capabilities for the remainder of the war.

Some CBR weapons have strategic capabilities, some are tactical weapons, and others might be used both strategically and tactically.

Biological warfare agents would be generally used as strategic weapons because of the lapse of time between their application and maximum effect. When directed against personnel there is a period of incubation averaging several days, during which individuals may be able to function nearly normally.[77] This characteristic would rule out BW for those tactical operations where speed of effect and precise timing were important, though in other cases they might be used several days in advance of an attack to soften up the opposition.

Crop-destroying agents are good examples of strategic weapons; the loss of a crop would not, at the time, affect tactical operations seriously since a country would usually have sufficient food reserves

[73] Ibid., p. 102.
[74] Congressional Record, op. cit., vol. 68, pt. 1, pp. 148-149.
[75] Baltimore Sun, Nov. 18, 1959, p. 40.
[76] Congressional Record, 72d Cong., 1st sess., vol. 75, pt. 4, p. 4361, 1st col.
[77] Fothergill, LeRoy D., "Biological Warfare and Its Defense," Armed Forces Chemical Journal, September-October 1958, p. 4.

on hand to enable it to fight at least for several months before it had to depend upon the new crop; but such a loss could have severe strategic repercussions since the eventual result would be something of the same nature as a blockade cutting off vital foods and supplies.

Chemical warfare agents of the past have been largely tactical in nature, but the nerve gases, for instance, have sufficient concentration and toxicity as well as persistence to permit their use as strategic weapons—especially against nations which lack adequate civil and military defense and discipline.

Radiological weapons vary from massive fallout, which would be used strategically, to the use of radioactive materials to contaminate a target area and interfere with its tactical use by the enemy.

IMPORTANT MILITARY CHARACTERISTICS OF CBR AGENTS

From a military point of view, one of the most important factors to be considered in plans to employ weapons is that of their military characteristics. While some of the characteristics of CBR weapons are mentioned in this study in connection with other topics, they are summarized below in order to give the reader a comprehensive understanding of the nature of these weapons.

(*a*) The range of effectiveness is so great that the commander may choose a weapon for almost any degree of effect desired—from temporary, harmless incapacitation of a small unit to a massive lethal attack against a large concentration. This selectivity makes it possible for operations to be undertaken against enemy troops occupying territory of a friendly people. The use of nuclear or high-explosive weapons would be destructive to friend and foe alike but if some agent such as the psychochemicals were available, the enemy might be overcome with a minimum of distress to the friendly population.

(*b*) CBR weapons are used mainly against personnel. Other than flames and incendiaries, CBR agents are not destructive to facilities. Thus, they offer the possibility of effective military action without the destruction of industrial plants, homes, transportation facilities, and cultural buildings. The lack of destructiveness of CBR agents to facilities makes them of little or no use in certain tactical situations where it is desired to destroy or disable bridges, tanks, or guns.

(*c*) The means of dissemination are many. Existing delivery systems for other weapons may be used, such as artillery, missiles, submarines, and aircraft. Or some new means might be devised like the Japanese incendiary balloons which were sent to burn U.S. forests in World War II. These balloons could easily be adapted to strew biological weapons over a broad area. Floating mines, devised to be carried long distances by ocean currents and to release their contents along shores where prevailing winds would spread germs inland, could be difficult to defend against. CB agents would be especially effective in clandestine operations against sources of water and food or in ventilation systems of large buildings. This kind of sabotage could be effective in connection with surprise attacks with nuclear weapons, provided precautions were taken to prevent "tipping off" the attack.

(*d*) CBR weapons are pervasive; they can seep into foxholes and underground installations, and reach troops who might be well protected against high explosives or even the immediate effects of nuclear explosions. The characteristic of pervasiveness, however, would offer

no special advantages over other weapons in fast-moving tactical situations where troops have not dug in deeply. In fact, where persistent toxic gases have been used to interdict the use of certain areas in fluid situations, any advantage to the user of the gas might be reduced if a turn of events likewise inhibited his own use of the areas which he had gassed.

(*e*) Chemical and biological weapons are relatively cheap and easy to produce. The raw materials are usually easy to acquire and do not need the immense industrial facilities for processing that are required for ships, aircraft, and missiles. This places these weapons within the capabilities of almost any small country. However, if effective dissemination should call for expensive delivery systems, this would rule out the use of CBR weapons by countries which could not afford these costly tools. (In respect to delivery systems, this is a field in which much research and development remains to be done since most of these systems are carryovers from the two World Wars and the improvements which were available in 1941–45 were not battle tested.)

(*f*) CBR weapons are more sensitive to meteorological conditions than other weapons, a limiting factor affecting their use.

VIII. Fiscal, Industrial, and Logistical Factors

The financial, industrial, and manpower resources involved in the U.S. CBR program are modest compared to most weapon system programs. Comparable Soviet statistics are not readily available but, as was pointed out in section V, the report that over 15 percent of the munitions in the hands of Soviet troops in Europe are chemical weapons, indicates that the Soviets have a sizable CBR program.

In comparing the cost of CBR weapons with others of comparable capabilities, one point which is sometimes overlooked is that the agent which does the damage—bomb, bullet, warhead, projectile, gas, torpedo—is usually much less costly than its delivery system. In the case of CBR weapons, many of the delivery agencies already exist, having been designed and produced for use with other agents of destruction. The same artillery which is used for high explosive shells can fire gas-loaded shells. The B–47's and B–52's of the strategic bombing force can spray CB weapons over large areas, and the same is true of our long-range missiles. While some new concepts for delivery may be needed or, indeed, are even in the process of development, the fact is that many of our existing weapons systems, with little additional cost for adaptation, could use CBR agents as alternative weapons.

The CBR program in our Armed Forces is carried on in peacetime by the Army; if this kind of warfare were to be used, however, the Navy and Air Force would have major responsibilities as well.

BUDGETARY SUPPORT

Of a total of about $9.4 billion appropriated for the Army in fiscal year 1960, the Chemical Corps had, as of May 27, 1960, received an apportionment of $103.4 million. The following table compares the original Chemical Corps estimates with what was tentatively approved at higher levels, and the final apportionment of congressional appropriations:

Fiscal year 1960

[In millions of dollars]

Purpose	Chemical Corps budget estimates [1]	Department of the Army tentative approval [2]	Apportionment, following passage of fiscal year 1960 Appropriation Act [3]
Research, development, test, and evaluation (R.D.T. & E., A)	72.3	39.7	46.5
Operation and maintenance, Army (O. & M., A.)	29.5	24.3	25.6
Procurement of equipment and missiles (PEMA) (excluding support of R.D.T. & E.)	37.4	14.9	31.3
Total	139.2	78.9	103.4

[1] House hearings on defense appropriations for fiscal year 1960, op. cit., pt. 6, p. 430.
[2] Ibid., p. 430.
[3] Information supplied by the Office of the Chief Chemical Officer, U.S. Army, May 27, 1960.

The following figures give a comparison between what the Chemical Corps proposed for its fiscal year 1961 programs and the amounts contained in the President's budget: [78]

[In millions of dollars]

Purpose	Chemical Corps proposed programs	Amounts in President's fiscal year 1961 budget
R.D.T. & E., A	55.3	55.3
O. & M., A	25.5	24.8
PEMA	53.7	53.7
Total	134.5	133.8

The increase of approximately $30 million in the fiscal year 1961 budget request is a reflection of increasing concern over the status of United States CBR capabilities. Secretary of Defense Gates advised the House Appropriations Subcommittee on Defense in January 1960 that there would be an increase in the budget request for CBR in the 1961 budget.[79] The purpose of the increase was explained by Gen. Lyman L. Lemnitzer, Chief of Staff of the Army, as follows:

> The increase in the budget for CBR activities is primarily for research and development to improve our defensive capabilities and to further explore the potentialities of modern chemical and biological weapons.[80]

PERSONNEL IN THE U.S. ARMY CHEMICAL CORPS

Like the budgetary support of CBR activities, the number of personnel engaged is also modest compared to the total in the Department of the Army.

At the end of fiscal year 1959 there were 8,404 civilians with the Chemical Corps of whom 5,091 were graded and 3,313 ungraded (blue-collar workers).[81] At the beginning of 1960 there were also 1,204 officers and 4,133 enlisted men in the Chemical Corps, a total of 5,337 military personnel.[82] Thus, there are less than 14,000 civilian and

[78] House hearings on defense appropriations for fiscal year 1961, op. cit., pt. 6, p. 297.
[79] Ibid., pt. 1, p. 72.
[80] Ibid., pt. 6, p. 622.
[81] House hearings on defense appropriations for 1960, op. cit., pt. 6, p. 432.
[82] Figures furnished by the Office of the Chief Chemical Officer, U.S. Army.

military personnel engaged in CBR activities, compared with approximately 503,000 civilians and 875,000 military personnel in the Department of the Army as a whole.

The total number of civilian personnel currently employed in CBR work is substantially less than the 13,119 as of June 30, 1953—the peak postwar figure. Where the $52 million payroll of 1953 produced about 13,000 man-years of effort, due to wage increases a $48 million payroll in 1959 produced 8,000 man-years. While there have been normal technological advances and increased efficiency, these factors have fallen short of offsetting the lower number of man-years which resulted from wage increases.

INDUSTRIAL ASPECTS OF CBR WARFARE [83]

The peacetime activities of the U.S. Army Chemical Corps which involve industry are largely in the research and development field. Besides a substantial number of research projects which have been placed with university and scientific institutions, the Chemical Corps presently has contracts with upwards of 25 industrial firms.

An active liaison is maintained between the corps and private industry to turn up chemicals which may have useful military applications. To protect private firms which might be reluctant to disclose a new chemical substance or an idea if their proprietary rights and interests were prejudiced, the Chemical Corps has set up a leakproof procedure for processing and investigating such information and materials. Several hundred products or formulas are usually received every month from these sources, which are screened and tested.

Approximately 7.5 percent of the current Chemical Corps budget is for research, development, test, and evaluation (RDTE) and procurement of equipment and missiles (PEMA). For fiscal years 1958, 1959, and 1960 the expenditures averaged 50.6 percent for inhouse activities (within Chemical Corps installations) and 49.4 percent for outhouse contracts (with private institutions and firms), including orders to private industry from Government arsenals.

There are several reasons for this division. First, it is to foster and develop service know-how, otherwise, in time the military would become barren of the skilled and experienced manpower necessary to meet CBR needs in time of war. Private firms, furthermore, object to manufacturing certain chemicals, such as highly toxic gases, because of the possibility of endangering their commercial products. On the other hand, the Chemical Corps depends upon universities, research organizations, and industry for much of its research and development program and for manufacturing of equipment, which is indicated by the fact that half of its funds, other than for operations and maintenance, are spent on the outside in the form of direct contracts or for materials ordered by inhouse installations.

The Chemical Corps has substantial industrial facilities of its own, including the Army Chemical Center in Maryland (with the Edgewood Arsenal); the Pine Bluff, Ark. Arsenal; Rocky Mountain Arsenal at Denver (now on a standby basis) and a plant at Newport, Ind., a former AEC installation now being converted to produce chemical agents. The last named will be a Government-owned, contractor-operated installation.

[83] In reading this subsection it should be remembered that the degree of industrial effort devoted to chemicals is far greater than to biological or radiological products and equipment.

These facilities can take care of the normal peacetime production needs of the military for CB warfare agents but the output would need to be greatly expanded if CBR warfare should be undertaken in a major war. This should not be too difficult in light of the large, thriving, and progressive chemical and pharmaceutical industry in the United States.

The latest census figures at hand show that there are around 11,000 chemical firms in the United States which produce upward of $8 billion of sales yearly.[84] These firms employ over 800,000 of whom about 500,000 are so-called production workers. Many other firms could be added because of their potential capabilities; for instance, breweries could be easily adapted to turning out BW agents.

The picture is one of the capability of producing almost limitless amounts of CB warfare agents, in geographically widely scattered installations; and this at relatively low cost, short leadtime for getting into production, and large output thereafter. This, of course, applies only to existing agents for which ample manufacturing experience and formulas exist; the leadtime for creating and going into production of a new agent could be as much as several years.

Countries like Great Britain, Germany, France, and others which have well-established chemical industries likewise should experience relatively little difficulty in producing CB weapons in large quantities as there is an ample supply of raw materials and enormous plants are not required for production. The military capabilities of these and other NATO countries, except Germany, are classified. Germany, as was explained in section III, is prohibited from possessing or using such weapons.

Facts as to the chemical industry of the Soviet Union are not easy to obtain, perhaps because the Soviets are disappointed in their progress in this field. Recently, top Soviet officials have been making strong efforts to bring this industry up to target levels, especially by purchasing equipment from the West. To accomplish this expansion, Premier Khrushchev said in a speech on February 10, 1959, at Stalinogorsk, that the Soviet Union planned to spend between 100 to 125 billion rubles in the next 7 years to develop its chemical industry.

Some comparison of the size of the chemical industry in the United States with that of the Soviet Union can be made by looking at the production figures of a few basic chemical products. The figures below are for 1957, the latest year for which figures were available for both countries.

Production in 1957

[In millions of short tons]

	United States	Soviet Union
Caustic soda	4.9	[1] 0.6
Soda ash	4.7	1.8
Sulfuric acid	16.4	5.0

[1] For 1956.

Source: U.S. figures: Statistical Abstract of the United States, 1959. Soviet figures: National Economy of the U.S.S.R. in 1958, Moscow, 1959.

[84] Statistical Abstract of the United States, 1959. Bureau of the Census.

These figures give only a partial comparison, however. The chemical industry of the United States is much more diversified than that of the Soviet Union, which is indicated to some extent by the relative amounts of chemical products which find their way into defense versus consumer use. One authority on Soviet chemical industry has said that in 1955, as much as 86 percent of the products of Soviet chemical plants went into military effort.[85] Regardless of the lead which the American chemical industry has, however, there is ample reason to believe that the Soviet chemical industry can support any plans for chemical warfare which the Soviets might decide to undertake; the same is also most certainly true as to biological and radiological warfare.

IX. Disarmament Problems

CBR WEAPONS IN DISARMAMENT NEGOTIATIONS

Since World War II there has been little discussion in disarmament negotiations of the reduction and control of CBR weapons. In many draft working papers submitted by the major powers, i.e., the United States, the United Kingdom, France, and the Soviet Union, the need to control and eliminate CBR weapons has been mentioned. These references, however, have taken the form usually of parenthetical inserts in proposals dealing with other arms control proposals. For example, at the first meeting of the United Nations Disarmament Commission in February 1952, three countries (France, Chile, and Turkey) succeeded in adding the words "including bacteriological weapons" in the Commission's program of work.[86] The United States also referred to bacteriological weapons in the context of a major proposal to eliminate all mass destruction weapons. But even with these references, no detailed discussion and negotiation took place.

The same situation prevailed to some extent in subsequent disarmament discussions within the United Nations. A resolution, passed by the United Nations General Assembly on April 8, 1953, which encouraged the continuation of disarmament negotiations, referred to CBR weapons as part of a general phrase for "the elimination and prohibition of all major weapons, including bacteriological, adaptable to mass destruction." [87]

In the disarmament discussions of 1955, 1956, and 1957, held by the United Nations Subcommittee on Disarmament, provision for the control and elimination of CBR weapons was included in many of the proposals by the five members of the subcommittee (the United States, the United Kingdom, France, Canada, and the U.S.S.R.), but again detailed discussions did not take place. Such references included a phrase in a British proposal for a control commission for disarmament which had among the categories upon which information would be needed "plants making chemical and biological weapons."

[85] Interview with Dr. J. G. Tolpin, Research Department, Standard Oil Co. (Indiana), chemical processing, April 1958.
[86] Disarmament (Background Paper No. 75/Rev. 1), United Nations Department of Public Information Mar. 15, 1955, Annex II, p. 14.
[87] Ibid., p. 14.

No disarmament negotiations took place during 1958 and 1959. In the 1960 disarmament negotiations undertaken by a Ten Nation Committee (The United States, the United Kingdom, France, Canada, Italy, the U.S.S.R., Poland, Czechoslovakia, Bulgaria, and Rumania), CBR weapons were mentioned in proposals submitted by both the Western nations and the Soviet Union.[88] The Western proposal of March 15, 1960, included measures to provide the necessary inspection and control of the prohibition of production of chemical and biological weapons as well as of the reduction of existing stocks of these weapons. In the only other major Western disarmament proposal submitted during these negotiations, i.e., the U.S. proposal of June 27, 1960, in the second of a three-stage plan a specified quantity of chemical and biological weapons and means for their delivery would be reduced to agreed levels and the resulting excesses would be destroyed or convered to peaceful uses.

The Soviet Union, in its proposal presented by Premier Khrushchev at the United Nations General Assembly on September 17, 1959, would remove and destroy under international control all stocks of chemical and bacteriological weapons in the possession of states. This would take place in the third of a three-stage plan. The other Soviet proposal that was introduced into the disarmament discussions, i.e., the proposal of June 2, 1960, included in the first-stage provision for a joint study to effect the cessation of production of chemical and bacteriological weapons and on the destruction of stockpiles of these weapons. In stage 2 the production of chemical and biological weapons would be prohibited.

Although both the Soviet Union and the Western Powers did introduce the above proposals dealing with chemical and biological weapons, these proposals were not discussed in detail during the 3 months in which the Ten Nation Committee met.

TECHNICAL PROBLEMS

The U.S. position is that any arms control or limitation program, to be considered seriously, must contain an effective inspection system in order to verify all reductions of weapons as well as any other disarmament measures agreed upon.

Disarmament negotiations in the past have repeatedly tripped over the inspection concept—as held by the United States—because the Soviet Union was not prepared to allow the degree of access to its territory and facilities which we held to be essential to a workable plan. The Soviet proposal of September 1959 brought up the matter of control and inspection by an international body but did not make clear how this group would function.

There is no denying that setting up an acceptable inspection system for CBR weapons would be an exceedingly difficult task. This was noted at the fifth Pugwash Conference held in Nova Scotia in August 1959 and attended by scientists from eight nations—including the Soviet Union and the United States. The final report contains this statement:

> However difficult the international control of atomic weapons may be, the international control of biological and chemical weapons by any system of inspection seems incomparably more difficult.[89]

[88] "Disarmament Developments—Spring 1960," hearing before the Subcommittee on Disarmament of the Committee on Foreign Relations, U.S. Senate, 86th Cong., 2d sess. U.S. Government Printing Office, 1960, pp. 37–43.

[89] On Biological and Chemical Warfare, Bulletin of the Atomic Scientists, vol. 15, October 1959, p. 399.

The scientists gave several reasons for their pessimistic views. First, there is such a large choice of possible weapons and combinations of weapons that it would be difficult to foresee which might be used on any particular occasion.

Again, CB weapons do not require elaborate or large-scale facilities for their manufacture. The raw materials are cheap and can be processed in ordinary chemical or microbiological laboratories under conditions where it would be most difficult to detect violations. How could one tell, for instance, whether a certain plant was preparing vaccines or making biological agents for weapons? Furthermore, it is relatively easy to shift from some chemical processes to others and this fact, added to the large number of possible facilities, would render effective inspection of manufacture so difficult as to be practically infeasible.

The third reason given by the Pugwash scientists was the diversity of the means of delivery, such as planes, missiles, ships and saboteurs. To prevent delivery, the scientists said, would mean banning all forms of transport, civil and military.

The scientists could have well added a fourth point: the ease with which research and development of chemicals and biologicals for the comfort and health of people can be diverted to the discovery of new or improved CB warfare agents.

POSSIBLE SOLUTIONS

In searching for areas in which feasible solutions might be found to the problem of control and inspection, some may be ruled out at the beginning. Any attempt, for instance, to control or limit the production of basic, everyday chemicals would be unworkable because these are the backbone of the widely diversified chemical industry which is vital to our way of life. They are the substances from which dyes, plastics, explosives, medicines, bleaches and a host of other useful products are derived. Yet these same chemicals are the basis of toxic gases.

Nor could research and manufacture of poisonous compounds be stopped without a serious impact upon world health; fungicides, germicides, insecticides, disinfectants and similar necessities are vital to good health, for how else can the world hope to combat rats, mosquitoes, lice, fleas and other pests which are vectors for plague, malaria, typhus and other dread diseases?

It would be just as impracticable to try to control the use of CB agents by banning the operation of international transportation systems such as planes and ships. Any arms control plan which would interfere seriously with either domestic or international commerce could not be expected to work.

International agreement

The Pugwash scientists concluded that the most hopeful approach to international regulation seemed to comprise—

(*a*) a general agreement to prohibit the use of such weapons (which they thought could be brought about by the ratification of the 1925 Geneva Protocol by all nations), and

(*b*) the renunciation of official secrecy controls over microbiological, toxological, pharmaceutical, and chemical-biological research.[90]

[90] Ibid., p. 339.

In 1932, a writer suggested a treaty worded like this:

> The signatory powers bind themselves not to use beyond the limits of their own territory gases or other chemical agents capable of producing fatalities in the concentrations used.[91]

This, the author pointed out, would permit a nation to use poison gas or any other chemical agent for defensive purposes if invaded, and would protect civilian populations because no nation would deliberately employ chemical agents in a manner which would injure its own people.

Both of these proposals run counter to the current U.S. policy: they would give up inspection and control as too difficult to attain and rely on international agreements to limit CBR warfare.

Inspection

Secretary of State John Foster Dulles said in 1956 that he did not think it "possible to arrive at a system of mutual inspection which is going to be absolutely 100 percent mathematically complete." The military risk of a less than perfect inspection system had to be balanced with the political risk involved in continuing the arms race without any limitations on armaments.

The question is—
he said—

> How much can you reduce the risks inherent in any inspection control system? It is my belief that they can be reduced to dimensions so that the taking of that risk involves less jeopardy for out country and for the human race, than the risk of doing nothing and allowing this menace to go on in increasing proportions where it is a terrible threat, I would say now, to the survival of a great portion of the human race. It could develop as a threat to the entire human race.[92]

If this philosophy is correct, it then becomes a matter of determining, insofar as chemical and biological warfare are concerned, what an inspection system could be reasonably expected to accomplish and what political and military risks might be involved. (The problem involved in devising an effective inspection system for radiological warfare is much different from that of chemical and biological warfare; it is closely related to the problems involved in controlling the production of fissionable material.)

An inspection system should be adapted to the scope of the agreement which it is designed to protect. If a ban on testing nuclear weapons is the objective, a satisfactory inspection and control system will be much easier to devise than would be the case if general disarmament were the goal. A system designed to protect nations against sudden attacks with nuclear weapons would involve surveillance of weapons delivery systems, many of which would be hard to conceal, such as airplanes, ships, and missiles, but it is a far different matter where chemical and biological weapons are concerned.

The characteristics of chemical and biological weapons make it possible to disseminate them in many more ways than is possible with nuclear weapons; therefore, if an arms control agreement is to cover CB weapons, the task of establishing an effective inspection system becomes much more difficult. This matter came up during a hearing before a House committee in March 1960. Maj. Gen. Marshall

[91] Mills, James E., "Chemical Warfare," Foreign Affairs, vol. 10, April 1932 p. 452.
[92] "Control and Reduction of Armaments," hearing before the Subcommittee on Disarmament of the Committee on Foreign Relations, U.S. Senate, 84th Cong., 2d sess., U.S. Government Printing Office, 1956, pt. 2, p. 54.

Stubbs, chief chemical officer of the U.S. Army, was asked if he thought there was any possibility that, as far as CBR was concerned, a disarmament program and agreement might be set up which could reasonably be expected to be effective. General Stubbs' reply was that he thought it futile to try to establish an effective control system as far as the production of agents was concerned. As to delivery systems, the control of missiles and similar means of delivery would be about the same as in the case of nuclear or conventional weapon systems but, in the case of chemical and biological weapons, the factor of covert delivery would be extremely difficult to control.[93]

There is some evidence, however, that certain kinds of inspection may improve the chances of the detection of clandestine testing and manufacture of chemical and biological wepaons. One authority, for example, differentiates between the research and development phase on the one hand and the production and field trial stages on the other. This authority contends that whereas research and development are extremely difficult to detect, production and field trials would be harder to conceal because these involve—

> both large-scale operations capable of handling large quantities of highly dangerous material and proving grounds located in areas of the country where, if an infection got out of hand, it could be controlled.[94]

There still remains, however, the technical problem of the detection of concealed stockpiles from prior production.

Delivery systems.—To mount nuclear attacks one must have planes or missiles—land or sea based—to carry the bombs and warheads, and ships, if nuclear mines are to be laid. To these means of delivery will someday be added space weapon systems. Chemical-biological-radiological weapons can be delivered by these same means and chemical and biological agents can be disseminated in many other ways, some of which probably have not been perfected or perhaps even conceived. Balloons, like the previously mentioned Japanese incendiary types, could be adapted to spread biological agents, and floating mines or similar devices might be set adrift in favorable ocean currents and timed or otherwise directed to release their biological agents when off the shores of the nation against which they were sent. Commercial sea and air transportation media, and under some circumstances land vehicles, could probably disseminate biological weapons more easily than nuclear mines could be planted, with less danger of detection, and perhaps with effects just as decisive.

General Stubbs, when questioned as to the practicality of a biological attack against a large country such as the United States, said he thought it was technically feasible. Ten carriers—planes or missiles—each carrying 5 tons of dry biologic agents could mount such an attack and they would not have to fly at treetop levels but could fly at high altitudes and drop packages which would open at lower levels and disperse their contents. With 10 carriers, employing a line attack, General Stubbs said he thought a potential enemy would get at least 30 percent casualties in the United States.[95]

Saboteurs.—The use of clandestine operatives has important possibilities. Insofar as nuclear weapons are concerned, there is a

[93] House hearings on Department of Defense appropriations for 1961, op. cit. pt. 6, p. 299.
[94] Groupé, Vincent, "On the Feasibility of Control of Biological Warfare," in "Inspection for Disarmament," edited by Seymour Melman, New York, Columbia University Press, 1958, pp. 185–190.
[95] House hearings on Department of Defense appropriations for 1961, op. cit., pt. 6, p. 286.

difference in the potential capabilities of operatives of nuclear powers and those from countries which do not have access to fissionable materials of weapons quality. In the latter case, assuming that the producers of fissionable materials were so careless as to allow unauthorized diversions of those materials and that countries failed to take effective steps to bar the importation of such illegally diverted materials, it is conceivable that saboteurs might obtain enough materials to assemble a few "suitcase bombs" at places where great damage could be done. If the saboteurs were agents of nuclear powers, the problem of acquiring the necessary materials would, of course, be greatly simplified and these "suitcase" operations could be made on a larger scale.

In either case, however, it would be practically impossible for saboteurs to plant enough of these weapons to destroy the retaliatory forces of a major nation, and sporadic attacks, by themselves, would hardly fit into a rational war plan of an aggressively minded country. In addition to the difficulties inherent in obtaining or smuggling the necessary materials, the risk of exposure would tend to diminish this kind of operation.

These difficulties would not apply to the same extent to the use of highly concentrated, highly toxic chemical and biological agents. Such substances would be much easier for saboteurs to acquire, they could be easily transported and concealed, and they could be disseminated in several ways, e.g., in water reservoirs, food supplies, office and plant ventilating systems and even in the forms of aerosols sprayed from planes, boats, or apparatus on land. The delayed effect of biological weapons also would make it easy for a saboteur to leave the scene of his operations without detection. In view of this, saboteurs or clandestine operatives—call them what you will—could conceivably operate against a nation with CB weapons in at least three ways. They might organize an attack on a scale which could make it possible for the aggressor to move in and take over control while key military and civilian leaders were incapacitated; they might direct their efforts toward incapacitating the retaliatory forces just prior to a massive nuclear attack; or their efforts might be much more subtle and extended over a long period of time in order to wear down the strength of their victim while avoiding detection as long as possible. If the last method were used, the purpose would be in connection with attrition; even if the potential strength of a nation were not seriously affected, the depressing effect of combating a series of internal epidemics and illnesses might be enough to divert national attention from subversive activities in other parts of the world which, under normal circumstances the nation would take steps to combat.

Under present conditions, it does not appear possible to devise an inspection system which would be completely effective against all kinds of CB warfare, although considerable effective surveillance seems feasible. The inspections to guard against nuclear warfare would cover the use of nuclear delivery systems for CB weapons. Radar and other warning devices would make it possible to set up a reasonably effective defense, it would seem, against balloons and floating mines. Rigid inspection of the kind used to guard against the introduction of dangerous weapons into the United States by sea and air might be extended to cover CB weapons as well, though with considerably increased difficulty. But the real rub would come in trying to protect

the country against the saboteur or underground agent because, as far as chemical and biological weapons are concerned, a great menace to the country from their use appears to be from clandestine use preceding an allout nuclear attack or as agents of attrition.

Exchange of scientific information.—The point has been made by some scientists that free exchange of scientific and technological information derived from chemical and biological research, development, testing and evaluation would remove much of the hazard from attacks from these sources. The Pugwash group suggested an agency for exchanging such information, formed along the lines of the United Nations Scientific Committee on Biological Effects of Radiation. While this might be a constructive move, and desirable from the standpoint of reaching the desired goal of good international relations, one possible undesirable result might follow; such information might assist one of the smaller countries which had aggressive designs against another country but could not mount an effective attack because it could not afford to acquire the necessary arms. This possibility might be outweighed after due consideration but it should not be ignored.

X. Concluding Remarks

Consideration of the merits and feasibility of the general subject of disarmament is not a part of this paper, but any plans or negotiations toward the goal of effective arms control and limitation should include consideration of chemical-biological-radiological weapons because of the potential danger from this kind of warfare.

In disarmament negotiations during the last decade, increasing emphasis has been laid on the importance of preventing massive surprise attacks which could, in effect, destroy a nation with one strike. In the case of the larger nations, this has meant taking measures to prevent massive nuclear attacks, since these have been the only weapons with sufficient coverage capacity to make it possible to destroy many vital targets at one time. The development in recent years of chemical and biological agents of much greater toxicity and effectiveness has increased the coverage capabilities and target effects of these weapons to the point where they may be considered as mass-casualty-producing weapons. Furthermore, within the foreseeable future there may be chemical and biological incapacitants which can disable persons temporarily without causing permanent injury and which may have sufficient capacity for coverage to give them strategic importance comparable with that of lethal CB and nuclear weapons.

The fact that CB incapacitants would cause no physical destruction and relatively few deaths does not mean that they would be necessarily less dangerous; for if a population could be incapacitated long enough for another nation to take control, the practical enslavement which could result might be as deplorable as a surprise attack resulting in widespread physical destruction.

Biological agents are well adapted to attrition tactics and are better than chemical weapons for use in clandestine operations because a series of epidemics or mass illnesses resulting from the use of biological agents would probably not arouse suspicion as quickly (if the attacks were carefully planned and executed) as would the use of toxic chemicals. Covert operations of this nature could conceivably be used to weaken a country to the point where its economy would be strained

and even its will to resist weakened, especially if these operations were carried out in connection with other nibbling tactics. Such operations would not have to be carried out only by the more powerful nations; the relative ease of manufacture and the wide availability and low cost of raw materials puts the possession of these weapons within the range of the smaller and poorer countries. While these nations would not be able to afford expensive delivery systems, they could engage in acts of attrition through clandestine operations.

Whether or not CBR warfare is more immoral and inhumane than other kinds of warfare, and what the policy of the United States should be toward the use of such weapons as part of its arsenal of offensive weapons, are not within the scope of this paper. These points have been brought up and the different views presented in order to give the reader the background necessary to an understanding of the nature of this means of warfare and how it is viewed in relation to other means of warfare.

As to the possibility of fashioning an acceptable, workable disarmament plan as far as chemical-biological-radiological weapons are concerned, the characteristics of these agents—especially chemical and biological agents—will make this difficult to accomplish. Inspection processes would probably leave more gaps than in the case of nuclear weapons because there are more ways of delivering CB weapons than nuclear weapons.

Inspection processes today would be likely to be more concerned with nuclear weapons since these offer the principal threat; however, this situation may change in a few years. This possibility—even probability—of an increase in the threat from CBR warfare points to why it becomes more difficult, from the technical standpoint, to arrive at satisfactory disarmament measures as time passes. The longer it takes to reach agreement, the greater the difficulties caused by the proliferation of weapon systems and the increase in the number of countries which have access to mass destruction weapons.

Since there will probably always be some aspects of CBR warfare which do not lend themselves to effective surveillance, parties to any arms control or limitation agreement will need to be prepared to accept some degree of risk. The more determined the parties to the agreement were to make it work, the less the risk would be; in fact, no disarmament plan is likely to work well—regardless of the effectiveness of its inspection system—in the absence of a favorable climate of international good intentions.

In the final analysis, the decision as to how far the United States can afford to go in accepting the risks attendant upon disarmament—risks involving not only chemical and biological weapons but other weapon systems as well—will rest upon an evaluation of the military disadvantages which might result from entering such an agreement and the political dangers inherent in a continuing arms race in the absence of such an agreement.

APPENDIXES

Appendix A

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Appendix B

President Roosevelt's Statement on Poison Gas Warfare [1]

From time to time since the present war began there have been reports that one or more of the Axis Powers were seriously contemplating use of poisonous or noxious gases or other inhumane devices of warfare.

I have been loath to believe that any nation, even our present enemies, could or would be willing to loose upon mankind such terrible and inhuman weapons. However, evidence that the Axis Powers are making significant preparations indicative of such an intention is being reported with increasing frequency from a variety of sources.

Use of such weapons has been outlawed by the general opinion of civilized mankind. This country has not used them, and I hope that we never will be compelled to use them. I state categorically that we shall under no circumstances resort to the use of such weapons unless they are first used by our enemies.

As President of the United States and as Commander in Chief of the American Armed Forces, I want to make clear beyond all doubt to any of our enemies contemplating a resort to such desperate and barbarous methods that acts of this nature committed against any one of the United Nations will be regarded as having been committed against the United States itself and will be treated accordingly. We promise to any perpetrators of such crimes full and swift retaliation in kind, and I feel obliged now to warn the Axis armies and the Axis peoples, in Europe and in Asia, that the terrible consequences of any use of these inhumane methods on their part will be brought down swiftly and surely upon their own heads. Any use of gas by any Axis Power, therefore, will immediately be followed by the fullest possible retaliation upon munition centers, seaports, and other military objectives throughout the whole extent of the territory of such Axis country.

[1] "American War Documents," edited by Cornwell B. Rogers. Current History, vol. 4, August 1943, p. 405.